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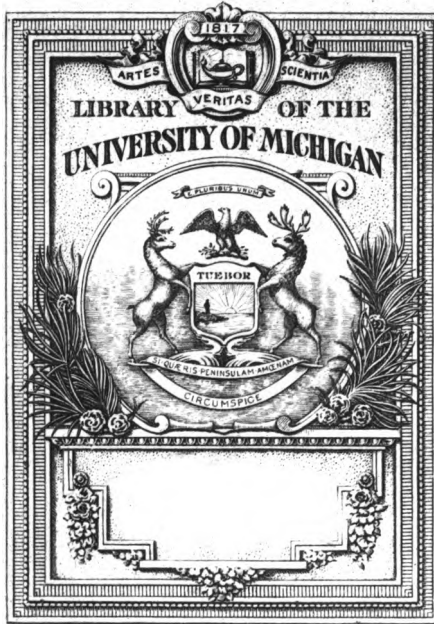
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ANNUAL REPORTS
OF THE
DEPARTMENT OF
AGRICULTURE

FOR THE YEAR ENDED JUNE 30,

1917.

REPORT OF THE
SECRETARY OF AGRICULTURE.

REPORTS OF CHIEFS.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1918.

[CHAPTER 23, Stat. L., 1895.]

[AN ACT Providing for the public printing and binding and the distribution of public documents.]

* * * * *

Section 73, paragraph 2:

The Annual Report of the Secretary of Agriculture shall hereafter be submitted and printed in two parts, as follows: Part One, which shall contain purely business and executive matter which it is necessary for the Secretary to submit to the President and Congress; Part Two, which shall contain such reports from the different Bureaus and Divisions, and such papers prepared by their special agents, accompanied by suitable illustrations, as shall, in the opinion of the Secretary, be specially suited to interest and instruct the farmers of the country, and to include a general report of the operations of the Department for their information. There shall be printed of Part One, one thousand copies for the Senate, two thousand copies for the House, and three thousand copies for the Department of Agriculture; and of Part Two, one hundred and ten thousand copies for the use of the Senate, three hundred and sixty thousand copies for the use of the House of Representatives, and thirty thousand copies for the use of the Department of Agriculture, the illustrations for the same to be executed under the supervision of the Public Printer, in accordance with directions of the Joint Committee on Printing, said illustrations to be subject to the approval of the Secretary of Agriculture; and the title of each of the said parts shall be such as to show that such part is complete in itself.

II



Science lit
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REPORT OF THE SECRETARY OF AGRICULTURE.

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REPORT OF THE SECRETARY OF AGRICULTURE.

WASHINGTON, D. C., *November 15, 1917.*

SIR: When, on April 6, 1917, the existence of a state of war with Germany was declared by Congress, this country was facing an unsatisfactory situation in respect to its supply of foods and feedstuffs. The production in 1916 of the leading cereals, corn, wheat, oats, barley, rye, buckwheat, rice, and kafirs was comparatively low, aggregating 4,806,000,000 bushels, as against 6,010,000,000 for 1915, 4,983,000,000 for 1914, and 4,884,000,000 the annual average for 1910-1914. The wheat crop of 1916 especially was strikingly small. It was only 639,886,000 bushels, as compared with the record production for 1915 of 1,026,000,000, with 891,000,000 for 1914, and with the average for the five years 1910-1914 of 728,000,000. It was certain, too, that on account of adverse weather conditions, the output of winter wheat for 1917 would be greatly curtailed. The world production of wheat for 1916 also was unsatisfactory, and the prospects for the ensuing year were not good. The situation was no better in respect to another conspicuously important food commodity, the Irish potato. The yield of this crop for 1916 in the United States was only 285,437,000 bushels, while for 1915 and 1914, respectively, it was 359,721,000 and 409,921,000. For the period 1910-1914 it averaged 360,772,000.

Even in normal times public attention fixes itself particularly on the supply of wheat and potatoes. In time of war it does so much more intensely, especially on the supply of wheat, which is peculiarly important from a military point of view. Because of their shortage here and elsewhere and of the large foreign demand, apprehension and, in some quarters, hysteria developed. The supply of meats and of poultry and dairy products was somewhat larger than in the years immediately preceding, but the foreign demand was great and increasing and exports were steadily rising. It was obvious that the supply of feedstuffs would not be normally abundant, and that it would be difficult to maintain the usual number of live stock

and practically impossible within a reasonable time to increase it. Then, too, competitive purchasing by foreign agencies on a large scale of all food products was prevalent, and manipulation and speculation were rife. Prices were mounting rapidly and conditions of living were becoming more difficult.

INITIAL EFFORTS TO INCREASE PRODUCTION.

It was recognized even before the war that the food problem was serious and that constructive action was necessary. This Department accordingly had taken steps to allay unnecessary apprehension, to promote economy and thrift, to secure fuller conservation of farm products and of foods, and to insure increased production of all essential agricultural commodities. The many agricultural agencies of the Nation began to direct attention to these problems and to cooperate effectively with the Department. The increased need of this Nation and of the world for food from our farms and the importance of greatly increasing production were emphasized. In the South, in particular, where effective work had been done for years to secure a diversified agriculture and greatly to increase yields of staple commodities and where unusual opportunities to increase food products were presented, a special campaign was conducted by the Department in cooperation with agricultural colleges and other agencies, with the effective aid of the daily press, agricultural journals, farmers' associations, bankers, and other business men. Many pertinent bulletins and circulars were distributed. The farm-demonstration machinery was fully utilized. More energetic action everywhere was taken to combat plant and animal diseases.

In January, 1917, appeals were sent to the South to help feed the Nation, to supply its own necessities so far as possible, and to produce a surplus of foodstuffs. It was urged especially that each farm family make a home garden, plant enough corn to last the family and the live stock for a year, raise sufficient oats and other small grain to supplement the corn, as well as the necessary hay and forage crops for the live stock, and produce the meat, poultry, and dairy products required by the family; and also to devote adequate attention to cotton as the main money crop.

In February special emphasis was laid on the necessity of raising beet seed on a large scale to make certain a larger supply of sugar beets. It was pointed out that before the war the beet-sugar in-

dustry had been almost wholly dependent on Europe for its seed supply, and that superior seed could be produced in this country, which could be further improved by selection and breeding. About the same time a warning was issued to cattle owners to make arrangements for the proper feeding of their cattle until spring, in order to prevent heavy losses in breeding animals. In each instance suggestions as to the methods to be followed were offered.

In March it became certain that a large percentage of wheat in the West and Pacific Northwest had been winterkilled. Information as to the course to be pursued was issued to the farmers of the winter-wheat section. It was suggested that where the crop had been not more than half killed it might be advisable to let the remainder grow, but that some other food crop should be started without delay.

In the meantime, I had appointed a committee of specialists of the Department to study the whole agricultural situation and to make recommendations. On the 27th of March I issued a statement urging farmers to adopt measures to secure maximum returns from the farms. Special attention was directed to the necessity of careful seed selection, of controlling plant and animal diseases, and of conserving farm products through proper storage, canning, drying, and preserving. On the 5th of April a special plea was made for an increased production of corn and hogs, and on the 7th of April I appealed to the farmers to increase the output of staple commodities as well as of perishables.

THE ST. LOUIS CONFERENCE.

On April 4, two days before a state of war with Germany was declared, I telegraphed to the State commissioners of agriculture and presidents of the land-grant colleges—the official agricultural representatives of the several States—inviting them to a conference in St. Louis on April 9 and 10, 1917. Editors of farm journals were asked to meet at the same place on April 11. It was thought to be highly desirable to secure the views of the official agricultural representatives of the States and of other leaders of agricultural opinion. There was a generous response to the invitation. Very many of the State commissioners of agriculture and representatives of nearly all the agricultural colleges east of the Rocky Mountains were present at the two days' meeting. Sixty-five officials represented 32 States. On the third day about 75 representatives of the agricultural press

were present. A similar conference for the States west of the Rocky Mountains was held at my request at Berkeley, Cal., on April 13, under the leadership of President Benjamin Ide Wheeler, of the University of California.

At the St. Louis conference the entire agricultural situation presented by the emergency was thoroughly discussed. The major problems considered were the production of sufficient foods and feedstuffs not only for this country but also for the nations of Europe with which we are associated in this war, the conservation of farm products and of foods, the mobilization of farm labor, the regulation of storage and distributing agencies, and the further organization of all the Nation's agricultural instrumentalities—National, State, and local. A comprehensive program for execution under existing law and for additional legislation was unanimously adopted. This program was communicated to the Berkeley conference, which concurred in it. It is noteworthy that in two days the agricultural leaders of the country drew up a program the wisdom of the essential features of which has not been successfully questioned and the substantial part of which has been embodied in the Food Production and Food Control Acts. The prompt and effective handling of the situation was made possible by reason of the fact that the American people, generations before, had wisely laid the foundations of many agricultural institutions and had increasingly liberally supported their agricultural agencies. The Nation was fortunate in having had in existence for many years, for the purpose of promoting scientific and practical agriculture, its Federal Department of Agriculture, and a department of agriculture and a land-grant college in each State, as well as great farmers' organizations. It is interesting to note that two of these agencies, the Federal department and the land-grant colleges, had their National official recognition and their real origin in another period of stress—in 1862—in two acts of Congress approved by Abraham Lincoln.

It was recognized as of special importance that the views and cooperation of the great farmers' organizations of the Nation and of leading individual farmers be secured. I therefore invited representative farmers to come to Washington on April 23 to give advice and to make recommendations. They included mainly officials of the National Grange, the Farmers' Educational and Cooperative Union, the Gleaners, and the Farmers' National Congress.

The American Society of Equity was invited to send a representative. It was unable to do so, but proffered its cooperation. At this conference the agricultural problems confronting the Nation were again thoroughly canvassed. In general, the suggestions and recommendations officially made to the Senate in my communication of April 18 were indorsed.

ORGANIZATION.

In the meantime, pending action by Congress, the Federal Department of Agriculture, the State departments, the land-grant colleges, and other agencies actively devoted their attention to the immediate task in hand. Working in close cooperation with one another and with the farmers' organizations throughout the Nation, they immediately took steps to execute that part of the plan which had reference to a more perfect organization and coordination of the Nation's agricultural activities. The task was promptly undertaken of promoting in each State, in connection with the State council of safety, the organization of a small central division of food production and conservation composed of representatives of the State board of agriculture, of the land-grant college, of farmers' organizations, and of business agencies. It was suggested also that similar bodies should be provided for each local subdivision, and all were requested to devote their energies to the problem of increasing the production and conservation of food supplies and of promoting more orderly and economical marketing. Copies of the recommendations of the St. Louis conference and of those made to the Senate on April 18 were sent to the Governor of each State. It was urged that attention be given immediately to the perfecting of agricultural organizations along the lines indicated.

INAUGURATION OF FOOD ADMINISTRATION.

As a further step in organization, the Council of National Defense on April 5 invited Mr. Herbert Hoover to return to this country to advise with the Council in reference to the domestic handling of food supplies and the most effective ways of assisting the European nations with which we are cooperating to satisfy their food necessities. Subsequently, on May 20, after the Food Production and Food Control bills had been outlined substantially in the form in which they were finally adopted, the President issued

a statement indicating that he had asked Mr. Hoover to undertake the important task of food administration. The purposes of the proposed Food Administration and the necessity for it were set forth. It was stated that a sharp distinction would be drawn between the normal and emergency activities of the Government represented in the Department of Agriculture in reference to food production, conservation, and marketing on the one hand, and the special activities necessitated by the war relating to the regulation of food distribution and consumption on the other. "All measures," it was explained, "intended directly to extend the normal activities of the Department of Agriculture in reference to the production, conservation, and the marketing of farm crops will be administered, as in normal times, through that department, and the powers asked for (in the Food Control bill) over distribution and consumption, over exports, imports, prices, purchase and requisition of commodities, storing, and the like which may require regulation during the war will be placed in the hands of a Commissioner of Food Administration appointed by the President and directly responsible to him."

On June 12 the President, in a letter to Mr. Hoover, expressed the opinion that the inauguration of that portion of the plan for food administration which contemplates a National mobilization of the great voluntary forces of the country which are ready to work toward saving food and eliminating waste admitted of no further delay. It was pointed out that while in many ways it would be desirable to await complete legislation establishing the Food Administration, it seemed that, so far as volunteer effort could be assembled, there should be immediate action. Accordingly, Mr. Hoover was authorized to proceed in this direction at once.

LEGISLATION.

In compliance with a resolution of the Senate, on April 18 I transmitted to it certain proposals for increasing the production, improving the distribution, and promoting the conservation of farm products and foods. The suggestions were based in large measure upon the program adopted at the St. Louis and Berkeley conferences. The Committee on Agriculture in each House soon afterward took the matter in hand, held extensive hearings, and finally formulated two measures. In the preparation of these, there were two leading thoughts in mind. One was to speed up and add to the activities of

the Federal Department of Agriculture and its cooperating forces, so that they might attack aggressively the larger problems of production, conservation of farm and ranch products, home economics, and farm marketing. The other was to vest in the President regulatory powers, in considerable part of a commercial nature, to be exercised through an emergency agency rather than through any existing department, to deal with special and urgent National and international food problems growing out of the war. After an extended debate the two bills—the Food Production and the Food Control—were passed by Congress and approved by the President on August 10. Immediately upon the approval of the Food Control Act, Mr. Hoover was formally appointed Food Administrator to execute the provisions of the Act as far as they relate to food and feedstuffs.

THE FOOD PRODUCTION ACT.

The Food Production Act—"an act to provide further for the national security and defense by stimulating agriculture and facilitating the distribution of agricultural products"—is administered by the Department of Agriculture, and carries an appropriation of \$11,346,400 for the following purposes:

1. The prevention, control, and eradication of the diseases and pests of live stock; the enlargement of live-stock production; and the conservation and utilization of meat, poultry, dairy, and other animal products, \$885,000.

2. Procuring, storing, and furnishing seeds for cash at cost to farmers in restricted areas where emergency conditions prevail, \$2,500,000.

3. The prevention, control, and eradication of insects and plant diseases injurious to agriculture, and the conservation and utilization of plant products, \$441,000.

4. The further development of the Extension Service which is conducted in cooperation with the agricultural colleges in the various States, \$4,348,400.

5. Surveys of the food supply of the United States, gathering and disseminating information concerning farm products, extending and enlarging the market news services, preventing waste of food in storage, in transit, or held for sale, giving advice concerning the market movement or distribution of perishable products, and investigating and certifying to shippers the condition as to soundness of

fruits, vegetables, and other food products received at important central markets, \$2,522,000.

6. The development of the information work of the Department, enlarging the facilities for dealing with the farm-labor problem, and extending the work of the Bureaus of Crop Estimates and Chemistry, \$650,000.

While the Food Production bill was pending in Congress, detailed plans were formulated for carrying out its provisions as soon as it should become law. The Department therefore was ready to proceed promptly and effectively with their execution.

RELATION TO FOOD ADMINISTRATION.

It was apparent that the Food Production and the Food Control Acts dealt with very closely related matters, that effective cooperation between the Department of Agriculture and the Food Administration was essential, and that needless duplication of effort should be avoided. It was recognized that the relation between the two agencies was intimate and fundamental; that it was impossible completely to disassociate them and undesirable to do so. After a full conference a satisfactory working agreement was reached.

In a broad way, the Food Administration has as its prime functions the control and regulation of the commercial distribution of foods and feedstuffs, that is, of products which have reached the markets and are in the channels of distribution or in the hands of consumers, their conservation by consumers, and the elimination of waste, through the employment of regular official as well as volunteer agencies.

The Department of Agriculture continues to administer the laws placed under its jurisdiction and to direct its activities in reference to production. It also continues to make the investigations authorized by Congress and to furnish assistance to farmers and live-stock men in the marketing of their products; to stimulate organization among producers for the distribution of their products to the markets; and to promote the conservation of farm and animal products, especially of perishables through canning, drying, preserving, pickling, and the like. It retains its work in home economics, as provided by law, and cooperates in this field as heretofore with the agricultural colleges, through the Extension Service. It directs all these undertakings in greatly expanded form under the authority and with the funds provided by the Food Production Act. In their promotion it utilizes its own official machinery and enlists the aid of volunteers.

In the main, the Department of Agriculture deals with all the processes of farming and follows the products through the markets to the point where they are available, and are in requisite form, for actual consumption. It aids in these processes through investigation, advice, and demonstration; only in the case of certain products and processes has it regulatory authority. The Food Administration, however, has wide powers of regulation and direction of food materials and food products. Where the Food Administration through its powers can be of assistance to the Department of Agriculture in its field, it is at liberty freely to make suggestions, and, when necessary, to cooperate in execution; and the same relation obtains as to the Department's participation in Food Administration matters in which it has a vital interest and toward the promotion of which it can be of assistance.

ADDITIONAL MACHINERY DEVELOPED.

It early became apparent that there would be no little delay in framing and passing the necessary legislation. Time was the essence of the situation. Prompt action was necessary. It was essential that many of the recommendations included in the St. Louis program should be put into effect. Farmers already were in the field or had made their plans for the season. The Department and the State agencies therefore speeded up their work along the most promising lines with the forces and funds at their command. Projects not having an immediate bearing on the emergency were set aside in order that the energies of the workers might be concentrated on the main problems.

Assuming that Congress would enact, in part at least, the legislation desired to stimulate production and to promote conservation, the Department of Agriculture, in cooperation with the land-grant colleges, undertook the preliminary work of developing additional machinery and agencies; and, in a number of States, these additional agencies, including especially an extension of the farm demonstration force, actually were put into operation.

It was recognized that the Cooperative Extension System, with its combination of Federal and State administrative officers and specialists, county agents, home-demonstration agents, farm bureaus, and other local organizations, furnished a ready and effective means for the Nation-wide dissemination of the needed facts, as well as for prac-

tical demonstrations of the best methods of increasing agricultural production and securing the most economical utilization of the products of the farm. With remarkable promptness and unanimity, these agencies addressed themselves to the important problems of increasing and conserving the food supply and cordially furthered the Department's efforts in this direction. Fortunately, as the result of the investigations and experiments of the Department and of the State experiment stations, extending over many years, there was already available a large accumulation of scientific information ready to be put into practical use.

To supplement the work of the county agents, special pains were taken further to enlist the services of the specialists of the Department and of the land-grant colleges. They serve as the connecting link between the research workers and the Extension Divisions of the several States. The efforts of each specialist were directed immediately toward methods of food production and conservation. For example, the crop specialist centered his efforts on questions of soil improvement and profitable rotations for food and feed production, the horticultural specialist sought especially to increase the planting and yield of vegetables, and the animal-husbandry specialist assisted in the formation of pig clubs, baby-beef clubs, and poultry clubs, and in disseminating information concerning egg and poultry production.

EXTENSION WORK EXPANDED.

An appropriation of \$4,348,400 was made by the Food Production Act for the further development of the Extension Service. By the end of October more than 1,600 emergency demonstration agents, men and women, had been appointed, making a total of approximately 5,000 cooperative extension workers, including the specialists performing extension work, employed through both State and Federal regular and emergency funds. This number will be further increased as soon as men and women with the requisite training and experience can be secured. Nearly 750 additional counties are cooperating with the Department under the Food Production Act in employing county agents. The total number of men in the service now acting as county agents is about 2,000, and many district agents have been designated to supervise their activities. About 1,300 State, district, county, and urban women home-demonstration agents are

now at work. Of the 600 women now employed as emergency agents under the Food Production Act, 500 are working in counties, principally among farm women, and 100 have been assigned exclusively to urban communities. Over 100 additional assistants in boys' and girls' club work have been placed in the field.

When the plans are fully developed there will be at least one demonstration agent—possibly two, a man and a woman—in nearly every agricultural county in the Nation, and a woman in each of the large cities of the country to give advice regarding the production, conservation, and utilization of food products. These agents not only are performing the normal and emergency demonstration and educational work, but they are also assisting other branches of the Government in special directions, such as the Treasury Department in its Liberty Loan campaigns and the Food Administration in its food-conservation activities.

LOCAL ORGANIZATIONS DEVELOPED.

Conditions growing out of the war gave added impetus to the already well-established policy of extending and promoting local organizations to support, aid, and extend the influence of the county-agent work. The number of such organizations was rapidly increased throughout the country. In the 15 Southern States the number of community organizations of farmers formed to aid the county agents increased from 1,654, with a membership of 44,548, to 2,508, with a membership of 78,660. As in the South, so in the North and West, impetus was given to the organization movement already under way, and there has been an emphatic demonstration of the increased usefulness of the county agent when backed by a supporting local organization. In the 33 Northern and Western States the number of farm bureaus and similar local organizations was increased to 374, with a membership of 98,654.

Many thousands of farmers throughout the country were shown how to increase their producing power and place their farms on a business basis, with the result that their farm practice has been better balanced, soil fertility has been maintained, and production has been increased.

There was a notable development of the work among women along the line of productive activities, such as poultry raising, home butter making, gardening, and canning, and of household convenience, com-

fort, economy, and efficiency. The number of community clubs organized among rural women in the South increased from 250 to 1,042, and 1,635,000 women and girls actually participated in some form of emergency work.

The enrollment in the regular boys' clubs in the South was largely increased, and the total membership is now approximately 100,000. In addition, 20,000 boys were enrolled to assist in war emergency activities. These clubs have been a very important factor in the campaigns for improved farming and increased food production. The boys' and girls' clubs in the Northern and Western States, through their regular membership of 406,000 and an additional emergency enrollment of 400,000, drawn largely from cities and towns, have been an active and efficient agency in the campaigns for promoting food production and conservation, not only through such regular work as canning, drying, pickling, preserving, and the like, but also through various emergency projects, such as gardening, poultry raising, bread making, and other activities.

HOME GARDENING STIMULATED.

Special attention was directed to the importance of home gardens in all parts of the Nation. A series of 27 brief popular articles containing instructions for the preparation of soil, for garden planting, and for the care of vegetables was prepared and distributed. A special Farmers' Bulletin, *The Small Vegetable Garden*, was quickly printed, and more than a million copies were promptly distributed. Throughout the growing season the Department continued to supply the press regularly with practical timely information designed to encourage a second and even a third crop of vegetables. This campaign, supported by the efforts of county agents, other field workers of the Department, the staffs of the agricultural colleges, and private workers, stimulated, it is estimated, the planting of from two hundred to three hundred per cent more gardens than had ever before produced food in the United States in one season. This was particularly true in the South, where the work was a logical development of the "Safe Farming" program which has been advocated for several years.

SAVING FARM PRODUCTS AND FOODS.

The home-demonstration activities were immediately intensified. Early in the summer all home-economics extension workers turned

aside from their regular activities and aided in special campaigns for food conservation. Canning, drying, salting, and storing were emphasized in every State, and special stress was laid upon the importance of using perishable products in such a way that the home might support itself and make as little demand as possible on the transportation facilities for supplies from other sections of the country. Many demonstrations were given on methods of conserving wheat, sugar, fats, and the like. Excessive use of butter, meats, and sugars was discouraged and the use of substitutes was taught. Definite conservation campaigns were undertaken through the daily and weekly papers; many women's clubs were organized for the sole purpose of promoting home-economics extension work; community kitchens and community drying plants were increased in number and efficiency; many educational exhibits were made; and short and intensive training courses were held in 10 agricultural colleges for the preparation of emergency food agents and local volunteer workers.

The Department gave particular attention to problems of selecting and combining foods in such manner that the diet would be satisfactory and adequate and at the same time the consumption of commodities in which there was a shortage would be reduced. Data derived from experimental work on the rational and economical use of foods were promptly made available. A simple method for applying the results of the food investigations in a practical way was worked out and published.

To enlist the women of the Nation in a food-saving campaign, attention was called on March 3 to the fact that at least \$700,000,000 worth of food was being wasted annually in the United States. Subsequently, six separate appeals to the people to feed themselves, to watch kitchen waste, to prevent spoilage, and to conserve meat, milk, butter, and bread were issued through the press. These were followed by more than 65 simple circulars dealing with the effective use of foods and with economical and nourishing diets. Special efforts were made through press items to familiarize the Nation with the use of such foods as corn, rice, soy beans, rye, various legumes, cottage cheese, and skimmed milk. Many of the articles thus prepared were published as Food Thrift Series Nos. 1 to 5 and reached a direct circulation of more than a million and a quarter.

The services of an expert in home economics were placed at the disposal of the Woman's Committee of the Council of National Defense, and the Department has cooperated with the committee in many directions. Jointly with the Food Administration, a series of leaflets on foods, designed especially for extension workers in home economics, was prepared. As a part of the general survey of the food resources of the country a dietary survey of selected families in different parts of the United States was undertaken. Dietary studies also were made in selected families of the District of Columbia as a part of the study of living conditions carried on by the Department of Labor.

CONSERVATION OF PERISHABLES.

When it became apparent that the truck farms, home gardens, and orchards of the Nation would produce a large surplus, the Department, supplementing the activities of the extension forces and aided by a large number of emergency agents, conducted an intensive publicity campaign, under the immediate direction of a special assistant, to promote the canning, preserving, pickling, and drying of surplus perishables and to stimulate the consumption of fresh fruits and vegetables. Mr. A. D. Lasker, of Chicago, and Mr. John Callan O'Laughlin, of Washington, D. C., volunteered to organize and supervise the work for the Department. Practically every newspaper in the 28 States which reported a heavy surplus agreed to devote space to the campaign. Within two weeks 110 articles teaching in a brief, simple way the household methods of conserving fruits and vegetables were supplied to the newspapers and promptly published by them. Special Farmers' Bulletins dealing with these subjects were quickly prepared and circulated to the number of 3,400,000 copies. The response to this campaign was immediate. Not only were perishables put up for winter use in greatly enlarged quantities, but the increased consumption, stimulated by the campaign, steadied the truck markets and undoubtedly prevented a considerable waste of valuable foodstuffs. In this way also the drain on the staple products was lessened. While there is no way of determining accurately how much food was put up in individual homes for later use, there is every reason to believe that thousands of families canned and preserved perishable products this year for the first time.

Steps had been taken early in the year to make sure that there would be a sufficient supply of containers. The price of tin cans

had increased to such an extent as practically to prohibit their use by the individual canner. At the suggestion of the Departments of Commerce and Agriculture manufacturers agreed to restrict the canning of nonperishable foods for several months in order to conserve the supply for perishable products. The States Relations Service also, in cooperation with the Bureau of Chemistry, the Council of National Defense, railroads, and manufacturers of tin cans, perfected an arrangement by which more than 10,000,000 cans were shipped in carload lots from certain factories direct to counties in the South and sold at cost, plus freight and handling charges. The net saving through this activity alone is estimated at more than a quarter of a million dollars.

MARKETING ACTIVITIES.

The work of the Bureau of Markets was greatly expanded. The market news service for fruits and vegetables, inaugurated during the fiscal year 1915, as well as that for live stock and meats, which was begun in the fiscal year 1917, was developed as rapidly as possible with available funds. Many of the projects of the Bureau were redirected in order to deal more effectively with emergency problems. The reports were particularly valuable in connection with the shipment of perishable products, and large numbers took advantage of the timely information furnished by them. During the fiscal year 1917 approximately 3,000,000 bulletins regarding car-lot shipments and jobbing prices of fruits and vegetables were distributed to over 52,000 individuals, including shippers, jobbers, distributors, and receivers. Market reporting stations were opened during the year at several important points, and the number of commodities covered was greatly increased. The first quarterly report of the supply of wool was issued on July 30 and represents the most complete inventory ever compiled of the wool supply in the United States. The reporting service for cold-storage holdings was rapidly enlarged and now includes 43 commodities.

From representatives stationed at important transfer points during harvest periods the Bureau of Markets secured telegraphic information on the car situation. These reports made it possible to place before the Commission on Car Service accurate information regarding the prospective movement of different crops and the need for cars. The Bureau also, through all available channels, has endeav-

ored to secure close cooperation between carriers and producers, shippers and distributors in the more efficient utilization of railroad equipment used in transporting food products.

MARKET NEWS SERVICES EXTENDED.

The passage of the Food Production Act made possible a marked expansion of the machinery of the Bureau of Markets. An appropriation of \$2,522,000 was provided for this purpose. The news services for fruits and vegetables and for live stock and meats were still further developed and were extended to include hay, grain, and seeds, and dairy and poultry products. Three general reporting services, one daily and two weekly, are conducted for perishables at 25 stations, as well as a local service for truck crops in certain cities.

Branch offices are now maintained at twelve important market centers for the purpose of collecting and distributing current information relative to supplies of live stock and meats, demands, prices, and other market conditions. Two daily and one monthly report for live stock and meats are issued. Data on wholesale meat trade conditions are secured daily from several of the largest eastern meat consuming and distributing centers, and a summary is immediately forwarded to the central live-stock markets in the West. Bulletins also are issued at the various branch offices before the day's trading in live stock begins, and this information is distributed throughout the United States. More than 60 stockyard companies report their current live-stock receipts and shipments, and a summary of the figures is issued after the first of each month.

Biweekly reports are made on hay and grain for certain sections. A semiweekly statement of bean prices, demand, and movement is made, and plans have been completed for issuing one each month on farm and garden seeds. Reports of daily car-lot shipments and jobbing prices of fruits and vegetables, as well as weekly summaries of car-lot shipments and a weekly market review, are made. Data on the carload movements of fruits and vegetables and of live stock, embracing returns from approximately 1,000 officials, are telegraphed daily by more than 400 different railroads.

A cooperative experimental reporting service was begun early in the year in the large wholesale farmers' market at Providence, R. I., on fruits and vegetables grown in the neighborhood. This service is conducted in cooperation with local truck-gardeners' associations

and the city authorities. It has demonstrated its usefulness in stabilizing local prices, and has been extended, under the Food Production Act, to the markets at Boston and Springfield, Mass.; Albany, N. Y.; Cleveland, Ohio; Grand Rapids, Mich.; St. Paul, Minn., and Denver, Colo.

INSPECTION OF FRUITS AND VEGETABLES.

The Food Production Act authorizes the Secretary of Agriculture to investigate and certify to shippers the condition as to soundness of fruits and vegetables and other food products when received at important central markets. Rules and regulations for carrying out this provision of the act were published on October 31, and the inspection service was inaugurated promptly in 24 of the large markets. This impartial and disinterested inspection service should lessen the uncertainty surrounding the marketing of perishables and stimulate economical production.

EMERGENCY FOOD AND FERTILIZER SURVEYS.

The most difficult undertakings of the Bureau of Markets under the Food Production Act are the war emergency food surveys. A preliminary survey, as of August 31, 1917, was planned and set in operation. This will be followed by one in more detail after the crops are gathered. The information sought covers 18 of the more important farm products and foods, in some instances groups of products, and falls into four heads, based on location and ownership, as follows: (1) Quantities of raw food products on the farms; (2) stocks of food products nearer the consumption stage in manufacturing, storing, jobbing, wholesale, large retail, and other commercial establishments; (3) stocks in retail houses, particularly in the small establishments; and (4) supplies of food in the household and current family consumption. The later survey will embrace many more items.

A determination of the quantity of food products on farms, particularly of cereals, live stock, and poultry, has been made by the Bureau of Crop Estimates. The holdings of manufacturing, storing, jobbing, wholesale, and other commercial establishments, including large retail houses, have been ascertained by the Bureau of Markets directly from each concern. Owing to the impossibility of covering all the smaller retail concerns, the survey, so far as these were concerned,

was limited to the establishments in a number of representative cities and rural districts and was conducted by personal canvass instead of by mail. From the data secured the aggregate for the entire country will be estimated. Similarly, the supplies of food actually in the households will be determined by ascertaining the stocks in a large number of homes, and the returns will be checked by a careful record of the quantities of food purchased and consumed in them during the period of one week.

The Food Production Act provides also for the investigation of basic facts relating to fertilizers. An effort is being made to secure accurate information regarding the supply of fertilizer materials on hand, the probable production and consumption, and other pertinent facts. A special inquiry has been made through the Extension Service to ascertain the immediate requirements of farmers for nitrate of soda.

CONTROL OF PLANT DISEASES AND INSECTS.

Immediately after the outbreak of the war, the Bureaus of Plant Industry and Entomology directed their attention to plant diseases and insect pests and rendered very effective assistance with the resources at their command. With the additional funds made available by the Food Production Act, specialists of the Bureau of Plant Industry, familiar with the possibilities of seed treatment for the prevention of smuts of wheat, barley, oats, and rye, which alone cause losses of fifty to sixty million dollars a year, were placed in Oregon, Ohio, New York, Tennessee, Indiana, Illinois, Oklahoma, Texas, Washington, and California. These specialists conducted an active campaign to reduce these losses. Through cooperation with the county agents, farmers, farmers' organizations, and county and township schools, detailed suggestions for the protection of the wheat crop were given and were put into effect by many farmers. Similar work also has been undertaken in the Gulf and South Atlantic States.

Early in the spring the Bureau of Entomology made arrangements to secure systematic reports from various sections of the country regarding the prevalence of insects attacking food crops. It was essential to have readily available full and accurate knowledge of the exact conditions with reference to injurious insects, especially those threatening the staple crops. The reports received were promptly digested and transmitted to all State and station entomologists and others who were in a position to assist in reducing losses

from insect attacks. In this way the field workers of the Bureau, in cooperation with the State authorities, were able to deal more effectively with insect problems in many sections of the country. Under the provisions of the Food Production Act the Bureau has instituted an extensive campaign to disseminate information concerning means of preventing insect ravages and to demonstrate proper methods of control. It is planned to place 40 additional expert entomologists in the field to cooperate with the extension forces. Nineteen already have been appointed. They are dealing with the Hessian fly in the wheat areas, insects affecting truck crops—especially sweet potatoes—in the Gulf States, and those damaging deciduous fruits in the Appalachian region and citrus fruits in the South and in California. In the Northwest they propose to inaugurate an educational campaign directed against insects affecting cereal and forage crops. Six specialists in addition to the regular force have been assigned to the task of stimulating the production of honey.

CONSERVING POTATOES.

Sweet and Irish potatoes were planted more extensively than ever before. To reduce the losses resulting from improper handling and storage of the former, specialists were placed in the regions of large production, and their work, it is estimated, already has resulted in a saving of \$3,000,000. The methods of storing and handling Irish potatoes are well understood and the commercial practice in this field is fairly satisfactory. There is room, however, for great improvement both in quality and yield. A special survey, therefore, was undertaken to locate desirable fields of potatoes, free from disease and of good quality, which could be utilized for seed stock. Experts are now working on the problem in Maine, Vermont, Massachusetts, New Hampshire, Minnesota, Wisconsin, and Colorado.

PURCHASE OF SEED CORN.

To relieve the situation caused by severe drought in certain sections of Texas, and especially to insure a sufficient supply of good seed for the next planting season, steps were promptly taken to purchase a stock of approximately 37,500 bushels of seed corn for sale to farmers for cash at cost, as provided in the Food Production Act. The Department also, with the cooperation of the Food Administration Grain Corporation, undertook to insure an adequate supply of seed wheat

for planting this fall and next spring. The Grain Corporation permitted elevators to set aside special storage space and authorized them to charge a slight advance over the established price to cover extra charges. The Department located available stocks of seed, inspected them, certified to their soundness, and notified farmers where and on what terms they could secure such seed.

THE MEAT SUPPLY.

The task of increasing the meat supply, necessarily a slow one in its production phase, is particularly difficult. Hogs and poultry yield the quickest returns, and therefore urgent efforts were made to increase their production. Special campaigns were conducted by the specialists in animal husbandry, and the membership in the boys' and girls' pig and poultry clubs was greatly increased. Press notices designed to promote the raising of poultry were issued and later were incorporated in a special back-yard poultry leaflet, which was widely circulated. At the same time active steps were taken to stimulate the production of beef and dairy cattle, and several specialists in sheep husbandry were assigned to duty in the Eastern States to encourage the production of sheep on farms. Funds have been set aside from the appropriation made by the Food Production Act to employ a force of 32 additional men to give their entire time to the task of increasing the number of hogs, 39 to encourage poultry raising, and 6 to assist producers of beef cattle.

The transfer of cattle from regions where there was a shortage of feed to areas where feedstuffs were relatively plentiful has received special consideration. This work was begun late in June and is still under way. Field agents were assigned to Texas and Montana to locate cattle likely to be unwisely disposed of, and at the same time men were stationed in regions where there was an abundance of feedstuffs to locate prospective buyers. It is estimated that by the end of October this work had resulted in the transfer and saving to the Nation of more than 100,000 cattle.

On account of the severe winter and late spring in the West, the live-stock losses were very severe in every range State. It was urgent that the National Forest ranges be opened at the earliest possible date in order to prevent further losses, especially of lambs and calves. To meet this situation animals were admitted to the ranges earlier than usual and the number grazed was increased by approximately

350,000 over any previous year. Notwithstanding this action, the demand for grazing privileges could not fully be met. Obviously, the next important thing to be done was to provide for further utilization of the range in 1918. To study the effects of the increased use of the ranges this year, to discover in what particulars the present method of handling the stock and allotting the range might advantageously be modified as an emergency measure, and to secure the best available knowledge regarding the number of stock which the ranges can be made to carry with safety next year, a special inspection force has been organized. As a result of this study of the problem it will be possible to bring about a still further emergency use of the National Forest ranges for live-stock production in 1918.

CONTROL OF ANIMAL DISEASES.

The work connected with the suppression of animal diseases has been vigorously pressed. Special attention has been directed to the control of hog cholera and cattle ticks. Estimates show that the losses from hog cholera during the past fiscal year decreased by approximately 30 per cent and reached the lowest average per thousand head since 1894. More than 40,000 square miles were released from quarantine on account of the cattle tick during the past fiscal year and 1,788 on September 1, 1917. Sixty-five thousand five hundred and twenty square miles will be placed in the tick-free area on December 1. More than 51 per cent of the original infested territory has now been cleared of the tick. The work was greatly enlarged during the past summer, and many additional employees were assigned to it. The suppression of the tick makes possible the introduction of more and better beef and dairy cattle, and already thousands of fine breeding cattle have been procured by Southern farmers. Satisfactory progress has been made in the prevention or control of other destructive animal diseases.

Under the Food Production Act the facilities of the Bureau of Animal Industry for dealing with live-stock diseases have been further extended. Forty-six employees have been added to the tick-eradication forces in order that the work may be prosecuted more vigorously and additional areas be prepared for systematic effort next year. They have been assigned to duty in seven States. This force will be increased by 10 in the near future. In 12 States an

inspector has been detailed to assist in combating tuberculosis of cattle and swine and abortion of cattle, and it is proposed to increase the number to 19. In the control of blackleg of cattle and anthrax of domestic animals, five men are regularly employed. From time to time, however, as occasion arises, employees regularly assigned to other duties are detailed to the work of fighting these diseases. These activities of the Department now cover 15 States and will be extended to 10 more as promptly as possible. Sixty-five additional veterinarians have been assigned to the hog-cholera work. Fifteen more will be appointed as soon as competent men can be obtained. The fight against the disease has been under way for some time in 28 States, and as soon as the necessary arrangements can be made with the State authorities it will be carried into the remaining 20 Commonwealths.

THE LIVE-STOCK CONFERENCE.

In the effort to increase the meat supply, it seemed of the highest importance that the cooperation of the live-stock men of the Nation should be secured. Having this in view, in August I decided to ask representatives of the various live-stock interests to attend a conference in Washington on September 5 and 6, 1917. Shortly after the call for the conference was issued, in view of the interest of the Food Administration in many phases of the same matter, it was determined to have a joint conference and to create a National live-stock industry committee. People representing not only the producers of the various kinds of live stock but also the farm journals were invited to become members of the committee and to attend the conference. It was pointed out that there had been a tremendous slaughter of animals abroad, and that the destruction would continue at an accelerated rate. The duty of this Nation to supply food for its own citizens and soldiers and also to help feed the civilian population and soldiers of the Allies was emphasized. It was especially suggested that attention should be given to the problem of redistributing cattle, sheep, and hogs from areas where feed supplies were short to those where they existed in greater abundance. One hundred and eighty-five men, including representatives of the Department of Agriculture and the Food Administration, attended the conference, which lasted for two days. Certain recommendations, with many of which the

Department is in thorough accord, were made by the conference. Some of them had reference to undertakings which the Department and other agencies have had under way for some time and which have been enlarged in recent months. Among these are the following:

The extension of the live-stock reporting service of the Bureau of Markets; the vigorous prosecution of the work of eradicating the cattle tick; the encouragement of the boys' baby-beef clubs and pig clubs and the cow-testing associations; protective action against the stray dog, the enemy of the sheep; the extension of the work of education with reference to sheep raising and wool growing; and the redistribution of animals, to be promoted mainly through the county agents. Certain legislation was suggested, including, particularly, regulated grazing on the public domain, which this Department has earnestly favored for a number of years. It was urged also that steps be taken to control uneconomic speculation. It was understood that the United States Live Stock Industry Committee should continue in existence and cooperate with the Department and the Food Administration in bringing about the increased production, conservation, and orderly marketing of live stock.

PRODUCTION AND CONSERVATION OF DAIRY PRODUCTS.

Because of the large place that dairy products hold in food economics, efforts were made to conserve the supply by the elimination of waste and the more complete utilization of by-products. In many sections in the Southern and Western States the number of creameries and cheese factories was increased, resulting in large additions to the food supply and contributing to the welfare of the farming communities. In the settled sections of the Eastern and Middle Western States efforts were made to increase the efficiency of the operations on the farm and in the factory. The milk supply of many cities was improved and increased through the application of a few simple and efficient methods. In the South an active campaign for the greater production of feedstuffs, a necessary feature of dairy development, was conducted in cooperation with the extension authorities.

Every effort has been made to encourage the use of cottage cheese as a substitute for meat. A number of circulars and press notices explaining its food value and the ways in which it can be made in the home and in the factory were issued. Personal instruction also

was given to creamery operators, home-economics workers, and farm women. Six experts have devoted their entire time to encouraging the production of cottage cheese on the farm and this number will be increased. In the mountainous sections of the South special efforts have been made to increase cheese production. The establishment of cheese factories was encouraged in localities where climatic and other conditions render their operation feasible. Work was begun in these regions in September, 1914, when the first cheese factory was established in North Carolina. Since that time the number of factories has increased rapidly until at present there are 34, of which 26 were established during the last fiscal year. All have been successful. They furnish outlets for milk in localities far distant from railroads and centers of population, and in this way are of great benefit to isolated regions. While the work in this field is relatively new in the West, the results have been no less striking. Nine men were employed during the summer to promote the utilization of by-products of creameries and milk plants. The work was conducted in eight States and plans are under way for its further development.

WHEAT AND OTHER CEREALS.

When a state of war was declared it was clear that spring wheat offered the only opportunity, in part at least, to make good the prospective shortage of winter wheat indicated by heavy winterkilling. County-agent leaders, therefore, in cooperation with the Department, immediately put into effect plans for increasing the production of spring wheat, as well as of oats, barley, corn, potatoes, buckwheat, soy beans, grain sorghums, and other food crops, with the result that the total acreages planted were much larger than they would otherwise have been. For example, the seeding of spring wheat, which promised to be only one-half to two-thirds the normal, was increased to normal; seed corn was more carefully selected and tested; and oats were more extensively treated for smut with a consequent increase in yields. Many farmers who previously had not grown potatoes at all planted sufficient for their own use, and many who had never grown potatoes as a market crop planted a large acreage.

The special campaigns in the South for the increased production of foodstuffs through the extension forces were very successful and gave a remarkable demonstration of the value of such educational

work, especially in an emergency like this. The net result was a marked increase in the planting of corn, soy beans, velvet beans, cowpeas, peanuts, sweet potatoes, Irish potatoes, and other food crops. The corn crop in the 15 Southern States was 964,504,000 bushels, or more than a fourth of the whole crop of the United States.

FALL PLANTING.

Realizing the importance of continued efforts to promote the production of staple commodities and of making plans promptly for the immediate future, in June I appointed a committee of experts of the Department to make suggestions for future action, especially with reference to winter-wheat planting. The committee considered the problem from every angle and reached the conclusion that a strenuous effort should be made to secure the planting of an area that would, under favorable conditions, produce a billion bushels of wheat in 1918—880,000,000 bushels through the winter crop and the remainder through increased spring planting. The committee also recommended that steps be taken to encourage the production of over 83,000,000 bushels of rye and that the production of winter oats in the South should be increased to the extent that seed was available. This program called for the planting of 44,634,000 acres of winter wheat and 5,522,000 acres of rye, and was submitted by telegraph to the leading agricultural authorities of various States concerned. As a result of their suggestions it was finally determined to propose the planting of 47,337,000 acres of winter wheat and 5,131,000 acres of rye.

In announcing the program it seemed desirable to place particular emphasis on the crops seeded in the fall and to make no specific suggestion as to the spring crops, such as corn, spring oats, rice, the grain sorghums, and buckwheat until the acreages successfully sown to winter cereals could be determined. Similarly, action with regard to beans, soy beans, cowpeas, peanuts, and various other legumes, and the spring-planted forage crops, was left for final consideration until more complete data as to the 1917 harvest are available. It was suggested, however, that the acreages of fall-seeded hay crops should at least equal those of the present season. The need of husbanding seed supplies was pointed out, and the machinery of the Department's committee on seed stocks was set in motion to bring about an

effective interchange of seeds from well-supplied regions to those reporting shortages.

Through a number of channels the Department proceeded to bring the program to the attention of the grain farmers of the country and to seek their cooperation in making the recommendations effective. It was published as a circular and also was given wide distribution through the press and the Weekly News Letter. A series of conferences immediately was held by representatives of the Department in several of the grain-growing sections of the country. They were held in Washington for the Eastern and Northeastern States; in Atlanta for the Southeastern States; in Indianapolis for Indiana, Ohio, Michigan, Wisconsin, Illinois, and Kentucky; in Kansas City for Missouri, Iowa, Minnesota, South Dakota, Wyoming, Colorado, Nebraska, Kansas, Oklahoma, New Mexico, Arizona, Texas, and Arkansas; and in Spokane, Wash., for the remaining States. The local problems likely to be encountered in increasing the grain acreage were discussed with farmers, agricultural leaders, bankers financing agricultural enterprises, and editors of agricultural journals.

Following the publication of the program and the holding of the conferences, the Department carried on an intensive campaign to emphasize the need for an increased production of grain and the best methods to be employed in obtaining the increases suggested. Several special bulletins and posters were prepared and distributed, and articles discussing various phases of grain production and handling were issued through the general press, agricultural press, and the publications of the Department. The extension workers throughout the grain-growing regions concentrated their attention upon the problem and urged farmers to cooperate with the Department.

THE FARM-LABOR SUPPLY.

It was early apparent that in certain sections of the country, particularly near the great industrial centers in the North and Northeast and especially in the vicinity of plants undertaking large war contracts for the Government, there would be a marked shortage of farm labor. It was obvious, too, that, on account of the abstraction of labor through enlistments in the Regular Army and through the operation of the draft law, difficulties would be experienced in many sections of the Union. The situation called for constructive action. A large army can not be constituted without causing inconvenience

in many directions. It was clearly impossible to make exemptions by classes and to admit no farmers to the Army. Still, it was highly important that agricultural production be increased. Military failure could arise no less from shortage of foodstuffs than from shortage of ammunition or man power. The task was presented of making the labor remaining on farms more effective, of securing fuller cooperation among farmers, and of utilizing on the farms urban and rural labor not heretofore fully or regularly employed. Past experience made it clear that labor might be transferred from certain communities where the seasonal pressure had passed to others and where the need was immediate. It was known, too, that there were hundreds of thousands of boys in rural districts and villages who might render useful service, and that the army of boys and girls organized in agricultural clubs might be enlarged and its members employed in additional directions. It was assumed that there were more than 2,000,000 boys between the ages of 15 and 19 years in the cities and towns who were not engaged in productive work vital to the Nation, that many of these had had contact with rural life, and that their services might be utilized on the farms, especially in the harvest season.

The Departments of Agriculture and Labor and other agencies immediately after the outbreak of the war undertook to furnish assistance. The War Department itself held definitely in mind the thought of lightening the burden as far as possible by not calling to the colors those essential for leadership and direction. Under the pressure of the first draft it was difficult to work out satisfactorily the underlying principle of selection. For the future a system of classification was adopted which embodies the following features of special interest to farmers and agencies dealing with agriculture: The selectives are classified into five groups, indicating the order in which they will be called to service. Skilled farm labor is in class 2, highly specialized agricultural experts in agencies of the State or Nation in class 3, and heads of necessary agricultural enterprises in class 4. The operation of this new arrangement should remove many of the difficulties previously encountered and, in reasonable measure, meet the demands of the situation.

It was realized that after all was done there would be need of additional labor in many sections. The Department of Labor therefore undertook to study the available supplies in towns and cities

and developed its system of employment agencies for this purpose. One object was to secure information, which could be conveyed to the Department of Agriculture and to State agencies, as to available labor in urban centers and to have it drawn upon for aid in farming operations in near-by communities. The Department of Agriculture assumed the task of studying the supplies and needs in rural districts. It arranged to place a man in each State in touch with the State council of safety with the special duty of assisting in the mobilization and organization of rural labor. Under the provisions of the Food Production Act, 38 farm-labor agents have been appointed and are devoting their entire energies to the problem.

The problem of the organization of labor remaining in agriculture is of the highest importance, and it is essential that, if possible, it be so perfected that there may be produced in this emergency as much as was formerly produced by the whole number of laborers, and, if possible, a greater quantity. The experience of the present year has been valuable. Constant attention is being given to the problem, and it is hoped that during the ensuing months even more useful work may be done. A conference of all the labor representatives of the Department and of agencies with which they have been cooperating in the various States was held in St. Louis on November 9 and 10, 1917, to discuss the whole problem, to canvass the activities and results up to that time, and to make more efficient plans for next season. Whether resort in the future must be had to more drastic action on the part of the State and Federal authorities will depend upon the necessities of the case. Conscription of labor for industrial purposes would necessarily present many difficulties. Powerful influences are operating to bring about the release of labor and capital from less essential enterprises and their diversion into more urgent undertakings. These will become increasingly compelling as the situation develops. They will be aided by the growing realization on the part of the people generally of the necessity of curtailing expenditures on nonessentials and of redirecting labor and capital into vital industries.

CHEMICAL INVESTIGATIONS EXTENDED.

The Bureau of Chemistry has made considerable progress in demonstrating the processes devised by it for preparing sugar-cane and sorghum sirup that will not crystallize or ferment and for utiliz-

ing the by-products. The work already under way on methods of handling, packing, storing, shipping, and utilizing fish in order to make the supply more immediately available for food has been extended and developed. In connection with the efforts to increase the supply of poultry and eggs, plans have been made to stimulate the establishment of poultry and egg packing plants in accordance with the principles worked out by the Food Research Laboratory. Ten additional men are being assigned to this work. Arrangements have been completed with three small packing houses to serve as demonstrations for their communities and become centers for the distribution of information regarding better methods of handling, packing, and shipping. The work of determining the proper methods of drying fruits and vegetables on a commercial scale has been continued and extended. The Bureau of Plant Industry is also giving special attention to the drying of agricultural products under farm conditions.

PUBLICATION ACTIVITIES.

The information service, which furnishes timely articles to the press regarding the activities of the Department and the results of its investigations and experiments, has been enlarged in several directions. Plans have been perfected for supplying information to the weekly newspapers, women's magazines, agricultural press, and others in more available form. On October 15, 1917, a number of agricultural editors were asked to come to Washington to discuss the work of the Department in this field and to make suggestions for improvement. They promptly responded and made a number of recommendations of a helpful character.

There has been an unusually large demand for the publications of the Department. Over 22,000,000 emergency Farmers' Bulletins, circulars, leaflets, posters, and the like were published from April 1 to November 1 in connection with the efforts to increase production, to eliminate waste, and to promote conservation, and an equal number of publications dealing with the regular activities of the Department were issued in the same period, making a total since April 1 of approximately 44,000,000. The special circulars and posters were distributed largely through the county agents and other cooperating agencies. Copies also were supplied to official organizations, war committees, civic associations, and patriotic clubs throughout the United States.

The interest in the exhibit work of the Department has greatly increased. Additional equipment has been secured, and the Department has participated in a large number of educational fairs and expositions of regional or National importance. This work has been particularly useful in connection with the efforts to promote the better conservation and utilization of farm products.

THE RESPONSE OF THE FARMERS.

Imbued with patriotic motives, influenced by favorable market prices, and falling in with the suggestions of the Department of Agriculture and of State agricultural agencies, the farmers of the Nation manifested much interest in the campaign for increased production and displayed efficient activity in reference both to plant and animal foodstuffs and feedstuffs. The weather conditions during the spring were generally favorable and, according to the unrevised estimates, the Nation will have, as the result of the work of the farmers and of all the agricultural agencies, approximately 3,191,000,000 bushels of corn, 659,797,000 of wheat, 1,580,000,000 of oats, 201,659,000 of barley, 56,000,000 of rye, 16,813,000 of buckwheat, 33,256,000 of rice, 73,380,000 of kafir, 439,686,000 of Irish potatoes, 84,727,000 of sweet potatoes, 15,957,000 of commercial beans, 42,606,000 of peaches, 11,419,000 of pears, 177,733,000 of apples, and 7,621,000 tons of sugar beets. These figures represent increases of cereals in the aggregate over 1916 of 1,006,000,000 bushels, and over the average for 1910-1914 of approximately 1,000,000,000 bushels, but a decrease of production in comparison with 1915 of about 199,000,000 bushels. It should be borne in mind, however, that the carry-over of cereals from last year was much below the normal and that the percentage of soft corn of the 1917 crop was unusually high. The figures also reveal the record crop of Irish potatoes of 439,000,000 bushels, 154,000,000 more than in 1916, and 79,000,000 more than the average for 1910-1914; an increased production of sweet potatoes over 1916 of 14,000,000, and of 24,000,000 over the five-year average; and of sugar beets of 950,000 tons over 1916, and of 2,230,000 over the five-year average. There was also the largest production of perishables on record. While authentic figures for meat, poultry, dairy products, and vegetable oils are not available for 1917, it appears, from rough estimates, that the quantity of these commodities for this year is slightly greater than for either 1916 or 1915, and exceeds the five-year average by two or three billion pounds.

The number of milch cows and other cattle has shown an increase during the last four or five years, the estimate for the former for the present year being 23,906,000 as against 22,768,000 a year ago and 20,497,000 in 1913, before the European war began, while that for the cattle is 43,291,000 as against 40,849,000 a year ago and 36,030,000 in 1913. Unfortunately, the number of sheep continues to decline; the estimate for 1917 is only 46,059,000 as against 48,483,000 a year ago and 51,482,000 in 1913. It is estimated that the number of hogs, which during recent years has shown an upward tendency, decreased over 4,000,000, or from 67,453,000 to 62,747,000. However, it is greater than it was at the beginning of the European war. The number of hogs varies from year to year more widely than that of the larger meat animals.

In considering the whole meat situation it should be kept in mind that there is a close relationship between the production of live stock and the supply of feedstuffs and that for more than a year past there has been a relative shortage of grains and of forage. The large production of these necessities during the present crop season should conduce to more satisfactory conditions for the producers of live stock and should, other things being equal, tend to bring about an increase. But with the destruction of live stock in Europe and the great demands from there for meat and fats, with consequent greatly increased exports from this country, it is clear that the supply will not be adequate for the domestic needs and for those of the nations with which we are associated in the war. The mere statement that the population has steadily increased in this country—the gain in the 10 years from 1908 to 1917 being 13,000,000—with an absolute decrease in the live stock for the same period, would sufficiently emphasize the seriousness of the situation if conditions were normal and the demand for meats and fats were not so urgent. The great importance of doing everything possible economically to increase the meat supply of the Nation I have strongly emphasized in each previous annual report and in many addresses. This is one of the great problems to which the Department persistently has given earnest and vigorous attention.

The actual increase in the acreage of fall-sown crops can not be accurately determined at this time. There is every indication, however, that the farmers in the sections where fall grains can be profitably raised have patriotically responded to the Nation's

call for more breadstuffs. Reports made to the Bureau of Crop Estimates in August, before the campaign for increased acreages was well under way, indicated an intention on the part of farmers to increase their sowing of winter wheat by about 10 per cent and of rye by about 3 per cent. If these intentions are realized, it will result in the planting of 44,100,000 acres of wheat and about 4,340,000 acres of rye. Reports received since August are to the effect that the fall-sown acreage of these two crops has been increased in nearly every State, although the drought in the Southwestern States and in portions of Washington has made it impracticable fully to carry out the planting program. The official estimate of the acreage of winter wheat and rye will be issued on December 19 after the planting of winter grains is completed in the South. Similarly, it is too early to determine the percentage of germination of seed actually sown, and therefore any prophecy at this time as to the actual harvest of winter wheat to be expected in 1918 would be merely a guess.

That the farmers of the Nation have generously responded to the appeals for increased production, and that much has already been done to insure a large supply of foods and feedstuffs, justifies no let down in their activities or in those of all agricultural agencies. On the contrary, even greater efforts must be put forth in the coming months if we are to meet satisfactorily the domestic demands and the needs of the nations with which we are associated in this struggle. There must be no breakdown on the farms, no failure of foods, feedstuffs, or clothing. I can not emphasize too strongly the urgent necessity of doing everything possible to bring about a still further increase in the production of all essential commodities, particularly of the staple crops and live stock.

COOPERATION WITH OTHER DEPARTMENTS.

Many of the Bureaus of the Department have rendered and are rendering definite assistance to the War and Navy Departments and other branches of the Government in connection with war problems. A few instances may be cited:

The Bureau of Animal Industry is cooperating with the Navy Department in the reinspection of meats and meat food products at 27 naval stations, and 67 inspectors have been detailed for similar work at the various Army camps, cantonments, forts, and other places. Approximately, 50,000,000 pounds of products have been re-inspected in this way. Unusual precautions also have been taken

to see that the meat and meat food products intended for the Army and Navy contain no harmful substances.

To insure a safe and sanitary milk supply for the Army cantonments and naval stations, the dairy specialists of the Department have investigated the local situations and have made suggestions for improvements. The inspection of large quantities of butter for the Navy also has been supervised by the experts of the Dairy Division.

All supplies of vegetables purchased and loaded on the naval supply ships have been and are being inspected by representatives of the Bureau of Markets. The importance of this work is indicated by the fact that it was necessary recently to reject 500,000 pounds of diseased potatoes.

MISCELLANEOUS ACTIVITIES.

The Office of Home Economics has studied emergency rations for the Army and Navy, as well as general questions relating to rationing for the Coast Guard Service. The Bureau of Chemistry has done considerable work for the military and naval services in preparing specifications for foods and in analyzing and investigating the products offered to them. It is also assisting these agencies in the standardization of their food supplies. In addition, the Bureau is conducting research investigations on the antiseptic qualities of some important compounds, which may be very useful to the Army and Navy Medical Corps.

The Bureau of Entomology has placed its experts in entomology, as well as all information on camp sanitation in its possession, at the disposal of the Medical Corps. The Bureau of Soils has cooperated effectively with the War Department in investigational work relating to fixed nitrogen and sulphuric acid. Experts of the Office of Public Roads and Rural Engineering have been detailed to assist the War Department in road building at the 16 cantonments, and valuable data have been placed by this Office at the disposal of the military authorities.

FOREST-PRODUCTS INVESTIGATIONS.

The emergency work in the field of forest products has assumed large proportions. The entrance of the United States into the war presented a host of new problems requiring solution. Standards and

specifications had to be revised to meet the emergency conditions. In some cases it was necessary to locate new sources of supplies and, in many instances, to find satisfactory substitutes for the materials previously used. A very important part of the work relates to methods of conditioning rapidly, through artificial seasoning, woods used in the manufacture of rifles, airplanes, and vehicles. Assistance in these directions has been rendered by the Forest Service to the War and Navy Departments and also to the Shipping Board and the Emergency Fleet Corporation, to various committees of the Council of National Defense, and to manufacturers of war orders. To press this work effectively it has been necessary to discontinue most of the peace-time investigations of the Forest Products Laboratory at Madison and to devote its research facilities and staff mainly to the study of war problems.

At the request of the War Department the Forest Service assisted in the organization of a regiment—the Tenth Engineers (forest)—for forestry work abroad. It selected and recommended to the War Department a list of officers who were experienced practical foresters and lumbermen. It also made arrangements to secure recruits, mainly woodsmen, lumbermen, and sawmill hands, and the necessary equipment, fitted to meet the conditions which operating in France would involve, was devised. It is now cooperating with the War Department in the organization of another similar regiment—the Twentieth Engineers (forest).

AEROLOGICAL WORK DEVELOPED.

The Weather Bureau has placed at the disposal of the Naval forces along the coasts of the United States and the Army timely and accurate weather information. The work of the weather stations along the Atlantic, Gulf, and Pacific coasts has been closely coordinated with the coast-guard and coast-patrol services of the Navy Department. Some of the forecasters of the Weather Bureau have been commissioned by the War Department and, in this way, the cooperation between the two agencies will be rendered more effective.

An appropriation of \$100,000 for extending the aerological work of the Weather Bureau in aid of aeronautics was included in the Army Appropriation Act of May 12, 1917. This sum became available on July 1, and steps immediately were taken to put into effect the

plans previously formulated for the establishment of five aerological stations in addition to the one already maintained at Drexel. The rapid development of this work is, of course, a matter of great importance in connection with the aircraft production program. The Bureau also has made arrangements for furnishing accurate weather information at the various cantonments, and it has assisted the War Department in the organization of its aerological observation work and of a regiment for the gas and flame service.

NEED OF WATER-POWER LEGISLATION.

For several years attention has been directed to the necessity of enacting proper legislation relating to the development of the water power of the Nation. It becomes increasingly urgent that amendments to existing law be made and that a well-rounded policy be decided upon. The present industrial situation, and particularly the scarcity and high cost of fuel and construction materials, have increased the cost of steam power and make it highly important that action be taken at the next session of Congress. Legislation which will make it possible to safeguard the public interests, and at the same time to protect private investors, should result in securing cheaper water power and in conserving the coal and fuel-oil supply. Since three departments of the Government are vitally concerned in water-power legislation and its possible terms and would be vitally affected by the administrative handling of matters under such legislation, it would seem desirable to consider whether it is feasible to devise an executive body on which the three departments will be represented and which will be able to utilize to the best advantage all their existing agencies.

THE FEDERAL AID ROAD ACT.

In the administration of the Federal Aid Road Act of July 11, 1916, very satisfactory progress has been made. The Office of Public Roads and Rural Engineering, which is intrusted with the burden of administering the act, has expanded its organization to provide the requisite machinery. Ten district offices with an engineer in charge have been established in as many areas. The work in the Washington office has been divided into two branches, management and engineering. The management branch deals with all administrative, fiscal, legal, statistical, and economic questions, while the engineering branch has charge

of all matters relating to construction and maintenance. This redirection of the work has greatly increased the efficiency of the office in the handling of Federal aid road projects and in maintaining close relations with State highway departments.

Probably the most significant result thus far of the operation of the Federal Aid Road Act has been the enactment by a number of State legislatures of effective road laws. Legislative action in some States was necessary to meet the requirements of the Federal Act, but many of the States have gone further and have recast their highway policies entirely. All the States have assented to the provisions of the act—42 by their legislatures and 6 by their Governors. Thirty-three had a highway department within the meaning of the act upon the date of its approval. The remaining 15 have since enacted legislation creating highway departments which comply with the terms of the law. The highway departments in 18 States have been greatly strengthened, specific appropriations to meet the Federal funds have been made by 10, and comprehensive maintenance legislation has been enacted in 9 States. Forty-two States now have satisfactory maintenance laws. Nearly all the States have submitted definite schemes or programs of work for the entire five-year period covered by the act or for the greater portion of it. The formulation of carefully prepared plans for the full period in advance of construction tends to prevent wasteful and haphazard undertakings.

Under the provisions of the act, 40 States have submitted 183 projects, involving a total of approximately 1,730 miles. Of this number, 139, embracing 1,182 miles and calling for an estimated expenditure, including Federal, State, and local funds, of \$7,947,114.50, have been approved. These projects involve Federal funds to the extent of \$3,455,573.76, or 23.75 per cent of the total allotment, \$14,550,000, to the various States for the fiscal years 1917 and 1918. Six projects, covering 40 miles, have been disapproved. Agreements have been entered into or are in the course of preparation in the case of 34 projects, aggregating 197.74 miles and involving \$990,600.84 of Federal funds and a total of \$2,225,944.74.

The full effect of the Federal Aid Road Act can not be measured by any comparison of funds expended in 1916 and made available for 1917, as many of the legislatures did not meet until early in the calendar year 1917. It is significant, however, that while the expenditures of State funds in 1916 aggregated \$40,969,000, it is esti-

mated that the expenditure of State funds in 1917 will reach approximately \$60,000,000, or an increase of nearly 50 per cent. These funds are distinct from local expenditures and indicate an advance in State participation in highway work.

THE GRAIN STANDARDS ACT.

The preliminary steps in connection with the Grain Standards Act were discussed in the last Annual Report and need not be repeated here. Progress has been made since that time in increasing the efficiency of the administrative machinery, and the work is now on a very satisfactory basis. Thirty-five supervision districts, with as many central headquarters, have been fully equipped for the task. Forty-one supervisors, 10 assistant supervisors, and 80 grain samplers, together with the necessary clerks and other employees, have been appointed and assigned to duty.

On February 6, 1917, tentative official standards for wheat were made public and hearings immediately were begun in all the important wheat sections and wheat markets of the United States. The final hearing took place in Washington on March 7, and the standards were promulgated in final form on March 31. They became effective for winter wheat on July 1 and for spring wheat on August 1.

Licensing of inspectors proceeded throughout the month of November, 1916, and on December 21 a complete directory of persons licensed to inspect corn was issued. Seven hundred and four applications for licenses to inspect corn and wheat have been received, and three hundred and forty-three have been approved. The demand for inspection of grain by licensed inspectors is steadily increasing. Approximately, 569 appeals have been taken to the Secretary of Agriculture under the provisions of the act through the various field offices.

The supervision of inspection has not been confined to the determination of appeals and disputes. Ten thousand six hundred and fifty-six official samples of shelled corn have been secured and analyses made to determine their true grade. This was done in order to check the accuracy of inspection as carried on in various markets and inspection departments. From December 1, 1916, to May 30, 1917, 237,595 cars of shelled corn were inspected and graded by licensed inspectors according to the Federal standards.

A comparative study of the results of inspection of wheat received at the large marketing centers under the Federal standards and under the standards in use prior to their establishment is of interest. Of the Hard Red Spring wheat which arrived at Minneapolis and Duluth during the months of September and October, 1914 and 1915, and which was graded according to the previously used standards, 5.9 per cent received a numerical grade of No. 1 Hard, 37.5 per cent a grade of No. 1 Northern, 24.2 per cent a grade of No. 2 Northern, 14.8 per cent a grade of No. 3 Northern, or a total of 82.4 per cent of the receipts graded No. 3 or higher. During the month of September and the first 15 days of October, 1917, 88.5 per cent of the Hard Red Spring wheat received at Minneapolis and Duluth, which was graded according to the Federal standards, graded numerically No. 3 or higher, as follows: No. 1, 52.6 per cent; No. 2, 25.4 per cent; No. 3, 10.5 per cent. It should be noted in this connection that the quality of this year's crop is high and that four grades are included under the former State standards, namely, No. 1 Hard, No. 1 Northern, No. 2 Northern, and No. 3 Northern, while under the Federal standards there are but three grades.

The offices of Federal Grain Supervision have cooperated with the United States Food Administration in the supervision of the grading of wheat for the purposes of the Food Control Act, and information and data secured in connection with the work under the Grain Standards Act have been placed at the disposal of the Food Administration and other branches of the Government.

THE PINK BOLLWORM OF COTTON.

A highly destructive cotton pest has made its appearance in Texas. Its presence there is a serious menace to the future successful growing of cotton in the Nation. During September, October, and November of this year the pink bollworm, for many years prevalent in Egypt, India, and Hawaii, and more recently in Mexico, was discovered at several points in Texas. It was found at two places in the vicinity of mills which received seed from Mexico in 1916. One of these was near Hearne, and the other at Beaumont. It was also discovered in fields 15 or 20 miles from the latter place. There appears to be no doubt that the insects were introduced through the imported seed. The other infestations, reported early in November, are on or near Trinity Bay, in the southeastern part of the State, and

are much more serious on account of their intensity and the wide area involved.

Very few damaged bolls were found at Hearne and Beaumont. The cotton in the fields in the vicinity of the mills at these places was quickly uprooted and burned. In some cases the ground was subjected to blasts of fire. The cotton already picked was so handled as to prevent any insects it might contain from escaping. Similar steps are now being taken in the fields referred to 15 or 20 miles from Beaumont.

In the Trinity Bay region the insect was first discovered at Anahuac. The latest information indicates that it has spread along the northern and eastern shores of the bay for a distance of approximately 100 miles. One thousand acres of cotton are involved. Many of the fields are somewhat uniformly and heavily invaded. While no definite information is available as to the origin of the outbreak here, it is suspected that the infestation is of several years' standing. The community is remote from Mexico, has no railroad connections, and, so far as can be determined, has received no seed direct from Mexico or from the mills which had imported seed from that country. It is not impossible that the presence of the insect is due to seed imported several years ago from Egypt. Fortunately, cotton culture in this section is limited in the main to the area near the bay, between which and the great cotton-growing sections of the State there is interposed a stretch of country in which little or no cotton is grown. The crop is usually moved directly to Galveston and Houston, where it is ginned and where the seed is manufactured into oil and cake. The isolation of the region will facilitate the eradication of the insect, but the task will be a work of great magnitude, and will compel resort to the full powers of the recently enacted Texas law authorizing the establishment of cotton-free zones and the destruction of infested cotton. It is proposed to establish similar zones near Hearne and Beaumont.

The pink bollworm, so styled on account of the color of the larva, is perhaps the most serious known enemy of the cotton crop. It destroys not only the bolls and lint but also the seeds and greatly reduces the yield of oil. It hibernates in the larval stage in the seed and has been carried to practically all the cotton-producing countries of the world. The damage it is causing in Egypt, India, Hawaii, and other countries indicates the seriousness of the menace to cotton culture in this country.

The pest apparently was introduced into Mexico in 1911 through Egyptian cotton seed. Its existence there, however, was not brought to the attention of the Department until November 1, 1916, when some infested bolls were received from a resident of the Laguna district. This discovery was followed by the immediate issuance of an order prohibiting the further entry into the United States from Mexico, except from the Imperial Valley, State of Lower California, of all cotton seed, cottonseed hulls, and seed cotton, and bringing under regulation and restriction as to ports of entry Mexican cotton lint of all kinds.

Strict rules and regulations governing the importation of cottonseed cake, meal, and other cottonseed products into the United States from Mexico and other foreign countries also were issued with a view to prevent the introduction of the insect with these products in uncrushed seed. Accurate information was promptly obtained as to the disposition of the seed which had been brought across the border under permit for milling during the season of 1916. It was ascertained that a total of 436 cars of seed had entered the United States within the year prior to November 4, 1916, and had been distributed among mills in different parts of Texas. A campaign was begun immediately to expedite the milling or destruction of the seed. This work was carried out with great thoroughness under the direction of experts of the Department in cooperation with the Texas Department of Agriculture, the mills concerned, and the Cottonseed Crushers' Association of Texas. A border inspection and control service covering all car, freight, baggage, and other traffic between Mexico and the United States also was organized and is in full operation.

To enable the Department to deal more effectively with the situation, an estimate for an emergency appropriation of \$50,000 was submitted to Congress on December 14, 1916. The appropriation, however, did not become available until March 4, 1917. In the meantime, the control work had been instituted as far as possible with available funds. During the growing season of 1917 all cotton fields in the vicinity of the mills which had received Mexican seed were frequently inspected to determine whether any pink bollworms had escaped to the adjacent fields. So far, the only evidences of such escape are the sporadic outbreaks at Hearne and at Beaumont. The fields will be kept under constant observation during the remainder of the year, and none of the locally grown seed will be used for planting next

season. The portion of the crop which was not destroyed will be rigidly controlled, the lint shipped abroad or fumigated, and the seed promptly ground up at the mills. The old cotton plants over a wide area will be pulled up and burned to prevent overwintering of the insect in undeveloped or dead bolls.

As a result of a conference held by the Department in Washington in July and participated in by the Commissioner of Agriculture of Texas and other experts from the State, a bill was prepared giving the State authorities power to cooperate with this Department in the establishment of cotton-free zones and local quarantines. This bill was presented at the special session of the Texas Legislature and has since been enacted into law.

It is planned to establish a cotton-free zone in Texas, approximately 50 miles in breadth, along the Mexican border. It is proposed not only to eliminate cotton culture in this area but also to eradicate all volunteer cotton. Similar zones will be established to include any infested areas in Texas or the other Southern States. Furthermore, the cotton grown on the Mexican side will be kept under observation, and the Department will cooperate with the Mexican Government, local authorities, and plantation owners in stamping out any outbreaks within 50 miles of the border. If the assistance of the Mexican Government can be secured, a thorough survey will be made of all Mexican cotton regions to ascertain the present distribution of the insect. This survey ultimately would be the basis for determining the possibility of exterminating the pest in Mexico. It may appear that the most effective and economical method of preventing the further invasion of the United States by the pink bollworm will be to undertake this task. It would involve large expenditures, but the seriousness of the situation might amply justify them.

To make it possible to carry out these preliminary plans, an estimate of \$500,000 was submitted to the Congress on June 22, 1917. On October 6 the sum of \$250,000 was made available in the Urgent Deficiency Act.

The spirit revealed by the farmers and the results of their efforts during the present year indicate that they recognize the responsibility resting upon them in this emergency. I am confident that they will patriotically continue to assume and to bear their full share of the country's burden. The farmers of the Nation have always shown their devotion to the cause of freedom and have not been slow to

respond to their country's call for men and means to defend its rights. They will not submit to Germany's dictation. They will not permit her to impose illegal restrictions on their privilege of going freely to any part of the world where they have a legal right to go or of sending their products into the open markets of the world. They will realize that the dictum of Germany that this country should not send its ships at will to the ports of great nations of Europe was not only unwarranted and impertinent, but also that, if it had been acquiesced in, it would have involved them very particularly in great direct financial loss and suffering. As the meaning of this struggle is more fully revealed, as it becomes increasingly clear that a contest is again being waged to determine whether the world shall be dominated by the will and policies of medieval despotisms or by those of free and enlightened modern States, and whether the mere right of might or the rule of law shall prevail in the world, and as it becomes more obvious that the surest way to force a righteous peace is to employ effectively all the resources of the Nation, the farmers will increasingly put forth their strength, send their sons to fight at the front, and see to it that neither this Nation nor those with which we are associated lack anything in the way of materials for food and clothing. It is incumbent upon them, as it is upon all other civilians, to work and to save, to seek no mere selfish advantage, and to reveal the same spirit of devotion and willingness to make sacrifices and to give all they are and have which animate the soldier in the trenches, if this struggle is to be brought to a satisfactory conclusion. Every facility that this Department can command to assist them will be freely placed at their service.

Respectfully,

THE PRESIDENT.

D. F. HOUSTON,
Secretary of Agriculture.

REPORT OF CHIEFS.

REPORT OF THE CHIEF OF THE WEATHER BUREAU.

UNITED STATES DEPARTMENT OF AGRICULTURE,
WEATHER BUREAU,
OFFICE OF THE CHIEF,
Washington, D. C., September 27, 1917.

SIR: I have the honor to submit herewith a report of the operations of the Weather Bureau during the fiscal year ended June 30, 1917.

Very respectfully,

C. F. MARVIN,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

In addition to the daily work of the Weather Bureau in its comprehensive and important service to the public, a prominent feature of the bureau's activities during the year has been the linking of its work with the military operations of the Government in the great war. This cooperation has been secured through arrangements for forecasting the weather over the region of actual warfare in France, the extension of aerological work to provide for the making of upper air observations for the benefit of the Army aviators, ballonists, and artillerists; and assistance to the Government and marine interests by vessel-reporting and seacoast stations and communication facilities in aid of coast patrol.

Never in the history of conflicts of the world has the weather proved such a potent factor as in the war that is now in progress in Europe. This is largely due to the use of aeroplanes, dirigibles, and captive balloons, to the highly perfected and powerful artillery, and to the modern methods of warfare first brought into practice in this conflict. Foreknowledge of existing and expected weather conditions, both in the air and on the surface has, therefore, become of the utmost importance. When active preparations for the military preparedness of this country were begun—when the declaration was made by the United States that a state of war existed with the German Government—it was apparent that the Weather Bureau had an important part to play. In recognition of this fact the Secretary of Agriculture communicated with the Secretary of War and invited attention to the service which might be rendered by the Weather Bureau in furnishing the fullest possible information concerning the meteorological conditions in the United States and adjacent regions. He also indicated the service that trained meteorologists could render as aids to commanders in planning military opera-

tions. The Secretary of War heartily accepted the suggestions and preparations were made at once for the fullest cooperation in carrying out the plan.

It was obvious that the activities of the bureau for the time being at least would necessarily be extended to two primary projects: (1) The forecasting of the weather for purely military operations, (2) the sounding of the upper air for the benefit of aviators, ballonists, and artillerists.

In connection with the first project, one of the foremost forecasters of the bureau has been commissioned major in the Signal Officers' Reserve Corps and has been granted a furlough from the Weather Bureau for that purpose. In the furtherance of his duties it is expected that the closest cooperation will exist with the French and English meteorological services in the use of data obtained by them, supplemented by additional observations in the field and cable reports from the United States and its possessions.

The official in charge of the aerological investigations of the bureau has also been commissioned a major in the Signal Officers' Reserve Corps and placed in charge of the military aerological work. The aerological work heretofore performed by the Weather Bureau will be continued, in addition to the enlarged activities made possible by the appropriation of \$100,000 for this work, as contained in the Army bill, which became a law May 12, 1917. This item reads as follows:

For the establishment and maintenance by the Weather Bureau of additional aerological stations, for observing, measuring, and investigating atmospheric phenomena in the aid of aeronautics, including salaries, travel, and other expenses in the city of Washington and elsewhere, \$100,000, to be expended under the direction of the Secretary of Agriculture.

It is planned that, for the duration of the war, the aerological work of the Weather Bureau and the Signal Corps shall be closely coordinated, and that such of the free-air observations made at the six primary stations to be operated by the Weather Bureau, as may be required, shall be made telegraphically available to the military authorities, supplementing similar observations made at the various military stations conducted independently by the Signal Corps. All of the data secured at the Weather Bureau and military stations will be turned over to the Weather Bureau for tabulation and study.

Some details of the work of the bureau during the past year are briefly summarized and discussed under separate topics, as follows:

FORECASTS AND WARNINGS.

DISTRIBUTION OF WEATHER FORECASTS.

There was a considerable increase during the year in the number of cooperating rural telephone lines, and a corresponding extension of distribution to the farming communities. The forecasts by this means reach the farmers in nearly all instances by noon of the day of issue, and reports show that the service is very highly valued. Distribution by wireless, which was expected to be extended, was abridged or suspended through the control of all wireless communications exercised by the Government as a military necessity. The distribution of the weekly forecasts was materially extended by tele-

graphing them to the central offices of about 250 rural telephone lines in the 13 central grain-growing States, by which they were made available to all the subscribers on those lines by noon of the day of issue.

WEST INDIAN AND CARIBBEAN SEA SERVICE.

The extension and improvement of the weather service in this region was accomplished, at already established stations, by the perfecting of arrangements for taking and telegraphing two observations a day during the period June 1 to November 30, and the taking of one observation a day during the remainder of the year. New stations were established at Belize, British Honduras; Bluefields, Nicaragua; Colon, Canal Zone; Guantanamo Bay, Cuba; and St. Thomas, Virgin Islands. The work of the extension of this service is still in progress.

ALASKAN SERVICE.

A full meteorological station was established at Juneau, Alaska, and arrangements effected whereby twice-daily reports are received from all Alaskan stations.

STORM-WARNING STATIONS.

The number of storm-warning stations on June 30, 1917, was as follows:

Paid stations, 150; a decrease of 35 during the year.

Cooperative stations, 145; an increase of 32.

Weather Bureau stations displaying storm warnings, 58; a decrease of 2.

The decrease in the paid stations and the increase in the cooperative stations are almost wholly due to the taking over by the United States Coast Guard Service of the duties of displaymen wherever practicable.

VESSEL WEATHER STATIONS, INCLUDING LIGHTSHIPS.

At the close of the year 47 of these were in operation, somewhat less than last year, owing to war conditions. Two lightship stations were added; namely, at Diamond Shoals and Heald Bank. The reports from these vessel weather stations were of great value during the hurricane season.

SPECIAL METEOROLOGICAL STATIONS.

Two special meteorological stations for forecast purposes were established during the year, namely, at Needles, Cal., and at Midway Island, in the Pacific Ocean. Reports from the last-named station have been found to be of great value in connection with the preparation of the weekly forecasts.

CONSOLIDATION OF FORECAST DISTRICTS.

The San Francisco (Cal.) and Portland (Oreg.) forecast districts were consolidated during the year, with headquarters at San Francisco, Cal.

SEVERE STORMS.

Four tropical storms, for which hurricane warnings were ordered, occurred during the year—two in July and one each in August and October. The first of these, that of July 1–10, developed in the west Caribbean Sea and moving northward passed over Mobile, Ala., July 5, causing a maximum wind velocity of 106 miles per hour at that station and 104 miles at Pensacola; these velocities being the highest on record at those stations up to that time. The unusually high tides and torrential rains attending this storm caused enormous losses in central and southern portions of the east Gulf States. The second, that of July 12–15, developed in the Bahama Islands and moved northwest, passing over Charleston, S. C., on July 14, with a velocity of 64 miles per hour from the northeast. No severe losses attended this storm. The third, that of August 12–18, was first observed in the vicinity of the Barbadoes and moved northwest through the Yucatan Channel and across the Gulf of Mexico, passing inland between Corpus Christi and Brownsville, Tex., on the 18th. Considerable damage was caused on the west Texas coast by the high winds, the highest velocity, estimated at 90 miles per hour, occurring at Corpus Christi. Some of the 20 vessels held at New Orleans on account of the warnings probably would have encountered the hurricane in the Yucatan Channel and might have met the same fate as the *Admiral Clarke*, which was lost on the night of the 16th. Vessel masters and agents who held their vessels until the routes were declared safe expressed the highest commendation for the manner in which the Weather Bureau kept them advised. The fourth, that of October 9–19, developed over the central Caribbean Sea, moved west across the Yucatan Peninsula and then northeast across the Gulf, passing over Pensacola on the morning of the 18th. Maximum wind velocities of 120 miles from the southeast at Pensacola and 128 miles from the east at Mobile, the highest on record at these stations, attended this storm. The storm did little damage, comparatively speaking, as ample precautions had been taken as a result of the advance warnings.

A storm of marked intensity, for which whole-gale warnings were ordered, passed over the Lake region on November 23–24. It was reported that these warnings were so thoroughly distributed throughout the region that no vessels left port until after the severe gales subsided; and further, that the absence of wrecks and loss of life is evidence that the marine interests generally heeded the warnings issued by the Weather Bureau.

SEVERE COLD WAVES.

A notable feature of the meteorological history of the year was the severe cold wave, which, reaching the Mississippi Valley by the night of January 31, overspread the entire eastern half of the country during February 1–3. On the latter date the temperature fell to 16° at Jacksonville and below freezing throughout the Florida Peninsula, Miami reporting a minimum of 28°, the lowest of record at that station. This was the most severe freeze in Florida since February, 1899. Ample warnings of the cold wave were issued well in advance, the accurate forecasts of expected minimum temperatures in Florida proving of great value.

STORM-WARNING SERVICE.

The work of improving the storm-warning service by the installation of the three-lantern system has gone forward, the installation on the Great Lakes having been completed in the fall of 1916. Preliminary plans for the installation on the South Atlantic and Gulf coast have been completed and material is either on the ground or en route. Plans for the extension of the system to the North Atlantic coast are well underway.

AEROLOGICAL INVESTIGATIONS.

The work of obtaining free-air observations by means of kites has been continued at the Drexel aerological station during the past year. The data thus obtained include atmospheric pressure, temperature, humidity, wind velocity and direction, electric potential, and cloud altitude and movement. Flights were made on all but 11 days during the year, and a daily telegram giving the atmospheric conditions at one or two selected levels in the free air has been sent to the forecast centers of the Weather Bureau at Washington, D. C., and Chicago, Ill. In addition to the daily observations, series of observations continuing for a period of 30 to 36 hours have been made whenever conditions were favorable. The data thus obtained enable the bureau to follow atmospheric changes in considerable detail. In all, 516 observations have been made during the year—July 1, 1916, to June 30, 1917. Of these 160 were made in 21 different diurnal series, the remaining 356 being made as daily observations.

Plans have been made for more practical application of the results of free-air investigations to problems connected with aeronautics and the firing of projectiles. With this end in view the bureau furnished an exhibit at the Aeronautic Exposition held in New York City February 8–15, 1917, and also participated in the discussion held at that time under the auspices of the Aero Club of America. A paper on "Aerology in Aid of Aeronautics" was presented at the symposium on aeronautics before the American Philosophical Society in Philadelphia on April 13, 1917. This paper is to be published by that society.

Since February, 1917, considerable work has been done in the preparation of a manual or handbook for aeronauts. It will include a survey of the different parts of the United States, showing relative suitability of various localities for the establishment of aeronautic stations and will also contain a summary of free-air conditions most likely to be met with under different types of pressure distribution at the earth's surface. Copy for this book has been nearly completed and will soon be ready for publication. Frequent conferences have been held with officials of the aeronautic branches of the War and Navy Departments with a view to establishing closer cooperation between these services and this bureau. As a result of these conferences, plans are being perfected for making free-air observations in aid of aeronautics and the firing of projectiles at several of the training camps, including those at San Diego, Cal., Pensacola, Fla., Mineola, N. Y., Hampton, Va., and others. Free-air wind data, as observed at the Drexel aerological station, are furnished daily

for the information of the balloon training school at Fort Omaha. In addition to this, the officers and men at this school have on several occasions used the kite field at Drexel in connection with their experimental work.

STATIONS AND OBSERVATIONS.

New, regular, full-reporting stations were established at Juneau, Alaska, in rented quarters; and at Port Arthur, Tex., in the Federal Building. No additional stations have been established, and there are now 203 principal or fully equipped stations.

OBSERVATORY BUILDINGS AND STATION OFFICES.

After several years of litigation, a decree was finally handed down on January 6, 1917, by the United States district court, Fargo, N. Dak., in the case of the United States *v.* Northern Pacific Railway Co., confirming title to Weather Bureau reservation at Bismarck, N. Dak. This decree gives to the United States (Weather Bureau) all that part of the property north of the railroad tracks, including projections of Second Street and Mandan Avenue, with the triangular pieces of land at the extremity of same, and secures for the Weather Bureau a valuable tract of land of about 3 acres which will insure the continuity of meteorological observations for the future as has been maintained since June 1, 1894. Action has been taken to change the location of the residence building and effect desired improvements at that station.

Pursuant to authority contained in appropriation act of the Department of Agriculture for the fiscal year 1917 a site for the proposed Weather Bureau observatory building at Cape Henry, Va., was purchased on the water front, consisting of lots 5 and 6, block 7, in all 15,000 square feet. Drawings and specifications were prepared for a building adapted to the special requirements of a fully equipped vessel-reporting and meteorological station and as the northern terminus of the Cape Henry-Hatteras telegraph line, and bids invited for the erection of the building, but without results, as all bids were too high. The appropriation being continuous into the next fiscal year further attempt will be made to secure the erection of a suitable building within the appropriation made therefor.

By decision of the judge of the United States district court, Seattle, Wash., dated June 12, 1917, the bureau is granted possession of lot No. 1, block 32, town site of Port Angeles, Wash., litigation in regard to which has been in the courts for some time.

COOPERATIVE CLIMATOLOGICAL WORK.

The increasing demand for information as to past and current weather conditions for all parts of the country, and from practically every standpoint of business, pleasure, health, etc., clearly indicates the great value to the public of the weather information now being gathered through the voluntary services of our corps of unpaid observers, located in nearly every county of the Union.

INSPECTION OF COOPERATIVE STATIONS.

A recognition of the great benefits to be derived from a more frequent inspection of cooperative stations by the trained officials of the bureau resulted in a considerable increase in this work during the past year, and provisions have been made whereby all cooperative stations are to be visited at least once in each three years if possible. Improvement is always noted in the records from stations that have been inspected; more uniform methods of exposure are adopted, points of doubt as to the manner of observing and recording the indications of the instruments are cleared up, the observers become more enthusiastic in their work, and frequently the continuation of a station, where the observer had grown tired of the work, results from the personal appeal of the inspector.

NEW CLIMATOLOGICAL SERVICE IN ALASKA.

Beginning with the new calendar year provision has been made for the establishment of a full climatological service for Alaska, with headquarters at Juneau. Reports are now being received with more or less regularity from about 60 points in that Territory, and printed summaries similar to those for the States are being prepared.

An annual summary of climatological data, 1915, for the Territory was prepared mainly at the central office of the bureau and printed at the Seattle station. Action has also been taken to prepare a similar report for 1916, which will likewise be printed at the Seattle office.

ATLAS OF AMERICAN AGRICULTURE.

The preparation of climatological data for the proposed atlas of American agriculture has progressed, and the precipitation section, consisting of about 80 separate charts and diagrams, illustrating in great detail the distribution of the precipitation over the entire country, together with about 15,000 words of text, have been forwarded to the Public Printer. Work on the temperature and miscellaneous sections, embracing about the same number of charts with appropriate text, has also been nearly completed and much of the matter has already been forwarded for printing.

SNOW AND ICE BULLETIN.

The weekly bulletin showing the snow and ice conditions over the country during the winter season was somewhat enlarged by additional reports from the high mountain regions of the West, thereby permitting better estimates of the prospective water supply for irrigation and other important uses. A new base chart, showing the latest attempts at depicting the topography of the country, put in use during the past winter, has added greatly to a proper interpretation of the snowfall values appearing on the chart and in the accompanying tables.

The snow bulletins issued for each of the western mountain States were also considerably enlarged by the addition of reports from points in the mountains.

OCEAN METEOROLOGY.

Action has been taken during the year to increase materially the number of vessels reporting over the North Pacific Ocean, where hitherto but little information has been available.

The charting of these reports has been taken up, and it is believed a comprehensive study of the weather over this vast area will add greatly to our knowledge of the origin, development, and progress of the storms entering the western part of the country.

TELEGRAPH SERVICE.

Weather reports (in cipher) are transmitted to and from about 200 Weather Bureau stations twice daily—at 8 a. m. and 8 p. m.—and approximately 800 forecast telegrams are sent daily from this office. In addition, there are audited at the Weather Bureau all telegraph, telephone, and radio accounts, amounting to nearly \$300,000 annually, dealing with about 60 companies, also all Weather Bureau telegraph and telephone lines and other line tolls for commercial business. Repairing and rebuilding of Weather Bureau lines is also supervised by the central office of the bureau.

Further revisions of circuits were made and put into operation during the past year, by which a yearly saving of over \$1,000 was effected, in addition to increasing the number of reports to several stations. A considerable saving also was effected by having certain contracts reduced.

BLOCK ISLAND-NARRAGANSETT SECTION.

The Weather Bureau owns the cable, three conductors 10½ miles in length, and the land lines are owned by the Providence Telephone & Telegraph Co. For the use of two conductors in the cable the Providence Telephone & Telegraph Co. furnish 15 miles of land lines, connecting with Narragansett Pier and Block Island ends of the cable, in addition to paying \$600 annual rental to the bureau.

This line affords telegraphic communication between Narragansett Pier and Block Island. Observational reports from the latter place are of inestimable value to the bureau. Block Island is also a storm-warning display station.

A leak in the cable was repaired last August at a cost of \$1,750.

Telegraph receipts during the year:

For commercial business	\$958. 29
For rental of conductors (2)	600. 00
Total receipts	1, 558. 29

Cost of repairs:

Ordinary	\$4. 00
Repairing cable	1, 750. 00

NORFOLK-HATTERAS SECTION.

This line is 162½ miles in length, including three cables—one across Pamlico Sound 3 miles in length, one three-fourths of a mile across Oregon Inlet, and one three-fourths of a mile across New Inlet.

This line connects with the Western Union Telegraph Co. at Norfolk. The United States Coast Guard Service telephone wires are attached to the Weather Bureau poles. During the year this line was almost completely rebuilt. The work of rebuilding was done by employees of the Coast Guard Service. Communication was interrupted for a total of 26 days during the year. The line is in first-class condition at the present time.

Total number of messages handled, 30,232.

Telegraph receipts, \$2,195.34.

Cost of repairs, ordinary, \$98.23.

MOUNT WEATHER-BUEMONT (VA.) SECTION.

(Telephone and telegraph.) Length, 5.9 miles. This line is not now in use.

No expense; no receipts.

KEY WEST-SAND KEY SECTION.

(Telephone.) Cable; no land lines. Length, 8½ miles. Used for vessel reporting and display of storm warnings at Sand Key. This cable was laid in 1903 and is in poor condition. A new cable should be provided; probable cost, \$25,000. Interruptions during the year: July, 1916, and December, 1916.

Cost of repairs, \$443.17. No receipts.

GLEN HAVEN-NORTH AND SOUTH MANITOU SECTION.

(Telephone.) Connects with the Citizens Telephone Exchange at Glen Haven, Mich., and works in connection with the Coast Guard Service. It is used for the display of storm warnings and for commercial business.

Interruptions, November 9, 1916, to January 5, 1917.

Cost of repairs, \$650.

Receipts, \$96.98.

ALPENA-MIDDLE ISLAND-THUNDER BAY ISLAND SECTION.

(Telephone.) This line is 22 miles in land lines and 5½ miles in cable. It worked well during the year. It affords communication between the above-named places for the display of storm warnings, and connects with Coast Guard stations at these places. It was interrupted for four days and seven hours during the year.

Cost of repairs, \$122.70.

Receipts, none.

GRAND MARAIS-WHITEFISH POINT SECTION.

(Telephone.) This line is 10 miles in length and connects with the Coast Guard telephone at Vermillion Station No. 9. It is used to obtain meteorological reports from Whitefish Point and for the display of storm warnings. No interruptions during the year. No expenses. No receipts.

BEAVER ISLAND SECTION.

(Telephone.) From Charlevoix to St. James, Beaver Island, Mich., 33½ miles cable, 1½ miles land; connects with the Michigan State Telephone Co.'s exchange at Charlevoix; is used for the transmission of storm warnings displayed at and for obtaining meteorological reports from St. James, and for commercial business. This cable was fouled by a steamer on April 22, 1917, and repairs were completed June 25, 1917, at an approximate cost of \$1,500; 2½ miles of cable having been carried away by the steamer.

Cost of repairs, \$1,500.

Receipts, \$495.80.

TATOOSH-PORT ANGELES SECTION.

(Telegraph.) Length, 95 miles. This line runs through a wooded country where lumbering operations are carried on very extensively. As fast as the land is cleared and roads built, the line is moved to the public roads. Several miles have been moved during the past year, and it is expected that considerable work of this kind will be done during the coming year, costing approximately \$750 for rebuilding and removing the line. It was interrupted for a total of 15 days and 20 hours during the past year.

Besides the use of the line for transmitting observational reports from and the display of storm warnings at Tatoosh Island and of commercial business between the stations and the interior, many commercial messages are handled to and from ships at sea through the United States naval wireless station at Tatoosh, which has direct communication with the line. Tatoosh also reports all vessels that pass in or out of the Straits of Juan de Fuca.

Cost of repairs, \$718.50.

Receipts, \$1,564.

NORTH HEAD SECTION.

(Telegraph.) Length from North Head to Fort Canby, Wash., 2½ miles land lines; from Fort Canby to Fort Stevens, 6 miles cable. By a working agreement with the Western Union Telegraph Co., direct communication is afforded with the Weather Bureau office at Portland, Oreg. The line also connects with the United States naval radio wireless station at North Head, which station is the relay point for Alaskan reports. In addition to giving the radio service a direct outlet for their business, this line is used to obtain important meteorological reports from and transmission of storm warnings to North Head. The cable was fouled on June 9, 1916, and repaired at a cost of approximately \$2,300. Communication was restored on May 19, 1917.

Total cost of repairs, \$2,348.74.

Receipts, none.

SAN FRANCISCO-POINT REYES SECTION.

(Telephone.) Length, 70 miles, 20 of which are leased from the Pacific Telephone & Telegraph Co. Fifty miles are owned by the Weather Bureau, 22 miles of which are attached to the Western Union Telegraph Co.'s poles. No charge is made for these attachments. The line is used for the transmission of observational reports and

storm warnings and for vessel reporting. The portion of the line owned by the Weather Bureau is in good condition, having been rebuilt during the past year.

Cost of repairs, \$2,142.37.

Receipts, none.

RIVER AND FLOOD SERVICE.

As foreshadowed in my last annual report, the work in connection with the issue of flood warnings has been strengthened during the year and extended to districts not hitherto covered. Two new river districts have been organized in California, one for the Los Angeles River, with headquarters in Los Angeles, Cal., the other for the Eel River, in Humboldt County, with headquarters in Eureka, Cal. The flood-warning service in Alabama has been extended during the year to include the Cahaba River, a tributary of the Alabama in the central portion of the State. In times of flood the rich agricultural lands along this stream are overflowed, greatly to the detriment of farming interests. It is the purpose of the bureau to anticipate, so far as possible, floods in this stream, in order that the resulting damage may be minimized.

A rearrangement of the substations in Montana and the establishment of three new stations along the Missouri in North Dakota has been effected. These changes have enabled the bureau to render more efficient service during the spring breakup of the ice in the Missouri throughout the Dakotas.

A small number of rainfall stations, reporting by mail and telegraph, have been established during the year in the watershed of the Lake of the Woods in the United States. The reports furnished by these stations are for use of the International Joint Commission, which, it may be remembered, has jurisdiction over all cases involving the use or obstruction or diversion of waters forming the international boundary, or crossing the boundary between the United States and Canada.

LOSS BY FLOOD IN THE UNITED STATES DURING THE CALENDAR YEAR 1916.

The aggregate loss by floods, computed as accurately as the circumstances will permit, was \$35,967,000. As in former years, a great share of this loss fell upon the agricultural interests. This unusually large loss was due principally to the movement over the east Gulf and South Atlantic States of two tropical storms, during July, 1916. Following these two storms there was an absence of destructive floods in all parts of the country, which lasted until March, 1917.

HYDROLOGIC WORK IN SOUTHERN CALIFORNIA.

Progress in this work has been slow because of the fact that the mountain region of Los Angeles County, Cal., where the work is being done, is practically uninhabited. It has been possible to establish 16 rainfall stations in the foothills and at points within the mountains accessible by trail. Four of the stations in this study are equipped with automatically recording rain gages that are visited once a week or oftener, when possible. Twenty-eight rainfall stations are now in operation.

INTENSIVE SNOW SURVEYS.

Intensive snow surveys were conducted on Cottonwood Creek, a tributary of the Boise River, of Idaho, also in the Paradise Creek Valley, in the headquarters of the White River of Arizona. These surveys were in addition to the series of daily measurements of the amount of snowfall made at elevated stations in the Western States.

PRINTING AND PUBLICATIONS.

The demands made on the bureau for printing and lithographic work of every description have been such as to tax our force and plant to their fullest capacity. The edition of the National Weather and Crop Bulletin, which was 3,750 copies at the close of the last fiscal year, had to be increased to 4,200 copies at present, although nearly 600 addresses were dropped during the annual purging of the mailing list in March. A reduction of 120 copies in the edition of the daily Washington weather map resulted from the purging process in April.

The following table shows the principal output of our printing plant during the year:

LITHOGRAPHIC.

	Copies.
Daily Washington Weather Map.....	467, 550
National Weather and Crop Bulletin.....	130, 470
Snow and Ice Bulletin.....	21, 670
Charts for Monthly Weather Review.....	551, 625
Charts for Climatological Data.....	615, 432
Map A.....	102, 516
Miscellaneous charts and maps.....	36, 925
Blank forms.....	13, 520

PRINTING.

Station map bases (Forms DD, E, and CM).....	6, 827, 600
Blank forms.....	2, 863, 055
Daily forecast cards.....	482, 240
Weekly forecast.....	9, 959
Monthly Meteorological Summary.....	2, 980
Forecast cards franked for stations.....	21, 554, 800
Rural free delivery slips.....	2, 183, 600
Covers.....	21, 840
Letterheads.....	108, 500
Climatological Data.....	29, 165
Envelopes addressed.....	57, 425
Memorandum slips.....	114, 550
Skeleton letters.....	8, 400
Cards.....	114, 010
Instructions.....	17, 591
Weather Bureau Topics and Personnel.....	4, 020
Amendments to Station Regulations.....	6, 275
Circulars and circular letters.....	26, 175
Labels and tags.....	147, 718
Binding and Meteorological Data, complete sets.....	3, 720
Flexotype work.....	7, 680
Miscellaneous prints.....	160, 975

PERIODICAL PUBLICATIONS.

The daily, weekly, and monthly issues of our periodical publications at the close of the fiscal year were as follows:

	Copies.
Monthly Weather Review.....	1, 475
Monthly Climatological Data for the United States.....	310
Washington Weather Map, 1st edition, daily, except Sundays and holidays.....	850
Washington Weather Map, 2d edition, daily, except Sundays and holidays.....	385
Washington Weather Map, Sundays and holidays.....	475
National Weather and Crop Bulletin (weekly from April to September, monthly from October to March).....	4, 200
Snow and Ice Bulletin (weekly during the winter).....	1, 210
Forecast cards (daily, except Sundays and holidays).....	1, 570
Weekly forecasts.....	875
Monthly Meteorological Summary for Washington, D. C.....	250

PAID SUBSCRIPTIONS.

The number of paid subscriptions on our mailing lists at the close of the year was as follows:

	Subscribers.
Washington Weather Map.....	43
National Weather and Crop Bulletin.....	575
Snow and Ice Bulletin.....	25
Climatological Data.....	11

Subscriptions for the Monthly Weather Review are filled direct by the Superintendent of Documents from the 100 copies furnished him monthly by this division.

Remittances received by the Superintendent of Documents during the year, covering subscriptions for Weather Bureau publications, were reported as follows:

Washington Weather Map.....	\$122. 45
National Weather and Crop Bulletin.....	135. 65
Snow and Ice Bulletin.....	9. 50
Climatological Data.....	59. 90
Station weather maps.....	207. 39
Total.....	534. 89

NEW PUBLICATIONS.

The following is a list of the principal nonperiodical publications issued during the year:

Daily River Stages at River Gage Stations on the Principal Rivers of the United States for the Year 1915. Vol. XIII. 176 pages. W. B. No. 582. July, 1916. Gov. Print. Office.

Weather Code, for the Transmission of Meteorological Observations. Revised edition, 1916. 100 pages. W. B. No. 584. August, 1916. Gov. Print. Office.

Weather Forecasting in the United States. 370 pages, illus., charts. W. B. No. 583. August, 1916. Gov. Print. Office.

Aerology No. 1. 67 pages, illus., Supplement No. 3, Monthly Weather Review. W. B. No. 592. December, 1916. Gov. Print. Office.

Instructions for the Management and Care of Storm Warning Stations. 26 pages, illus. W. B. No. 587. December, 1916. Gov. Print. Office.

Weather Forecasting, with Introductory Note on Atmospheric. Bulletin No. 42, second edition. 37 pages, illus. W. B. No. 598. January, 1917. Gov. Print. Office.

Annual Report of the Chief of the Weather Bureau, 1915-16. 282 pages, charts. January, 1917. Gov. Print. Office.

Description of Cloud Forms; revised edition. 1 sheet, illus. January, 1917. Weather Bureau Print.

Types of Anticyclones of the United States and Their Average Movements. 25 pages, illus., charts. Supplement No. 4, Monthly Weather Review. W. B. No. 600. February, 1917. Gov. Print. Office.

Aerology No. 2. 59 pages, illus. Supplement No. 5, Monthly Weather Review. W. B. No. 603. April, 1917. Gov. Print. Office.

Weather Code for West Indian and Caribbean Sea Observers. 32 pages. May, 1917. W. B. No. 612. Gov. Print. Office.

Relative Humidities and Vapor Pressures over the United States, Including a Discussion of Data from Recording Hair Hygrometers. 61 pages, illus., charts. Supplement No. 6, Monthly Weather Review. W. B. No. 609. May, 1917. Gov. Print. Office.

The Daily Weather Map, with explanation. 8 pages, 4 charts. June, 1917. Weather Bureau Print.

EXPENDITURES OF THE WEATHER BUREAU AT THE GOVERNMENT PRINTING OFFICE DURING THE FISCAL YEAR 1916-17.

	Copies.	Cost.
Blank forms and maps.....	10,058,800	\$10,750.78
Cards.....	6,000	22.73
Blank books.....	234	225.06
Binding.....	2,256	2,775.85
Posters, placards, charts, etc.....	7,100	553.19
Separates and pamphlets.....	35,600	1,317.84
Publications, miscellaneous.....	17,945	7,985.60
Publications, periodical.....	19,100	7,189.48
Congressional.....	1,009	4,178.63
	10,147,244	34,999.18
Amount allotted.....		\$35,000.00
Amount expended.....		34,999.18
Unexpended.....		.84

LIBRARY.

During the year, 827 books and pamphlets were added to the library, bringing the total strength of the collection up to about 36,300. On account of conditions abroad there was a marked decrease in the number of foreign publications received, and the files of many important foreign periodicals are seriously in arrears.

Considerable progress has been made in strengthening the station libraries, especially that at Chicago, which serves as a depository for a reserve collection of important books available for transfer to the central office or elsewhere in case of need.

SEISMOLOGY.

The work of collecting and publishing earthquake data, begun December 9, 1914, has been continued during the past year. These data are of two kinds, noninstrumental reports of earthquakes felt and instrumental records, often of quakes wholly imperceptible to the senses. The noninstrumental reports are rendered by all the regular stations of the bureau, about 200 in number, and also by nearly all the bureau's 4,500 cooperative observers. The instrumental records published by the bureau have been obtained in part by instru-

ments owned and operated by the bureau itself, one at Washington, D. C., the other Northfield, Vt., and partly through the cooperation of 18 additional stations distributed from Panama to Alaska and from the Hawaiian Islands to Porto Rico.

During the calendar year 1916, 131 earthquakes were felt within the borders of the United States proper. The great majority of these produced no damage whatever, and only six or seven were severe enough to produce even slight damage.

SOLAR RADIATION INVESTIGATIONS.

Solar radiation measurements of much the same character as those for 1915-16 have been obtained throughout the year at Washington, D. C., Madison, Wis., Lincoln, Nebr., and Santa Fe, N. Mex., and the results have been published each month in the *Monthly Weather Review*. The instrumental equipment at Washington has been increased by the purchase from the Smithsonian Institution of a pyranometer, which will be used principally in restandardizing recording pyrheliometers.

Excellent observations were obtained of a cloud layer of high haze that overspread the United States from the Atlantic coast southwestward to southern California at the end of July, 1916. These included measurements of the height of the haze layer, and its direction and velocity of movement, and descriptions of the brilliant twilight colors, especially the purple afterglows, that accompanied it. The measurements of height and movement are in accord with similar measurements of the movement of balloons above a height of about 16 kilometers, and are confirmatory of the existence of air currents from the east at these high levels. In California and Arizona the haze and the brilliant afterglows were observed until after the end of 1916.

Photometric measurements of the intensity of twilight previously made at Mount Weather, Va., have been supplemented by further measurements at Salt Lake City, Utah. These are summarized in the *REVIEW* for November, 1916. In connection therewith are published tables showing the duration of both civil and astronomical twilight at different latitudes; and the term "civil twilight," which does not appear in English dictionaries, is definitely defined.

At Salt Lake City photometric measurements have also been made of the intensity of twilight illumination on a cloudless day with a clear sky and on a similar day except for the presence of a dense layer of surface smoke. The measurements include illumination from direct sunlight, from diffuse skylight, and from the two combined, which latter is the total daylight illumination. They show that the total illumination averages about one-third less on a smoky day than on a clear day and that the illumination from direct sunlight averages one-half less.

A study has been made of the shading effect of wire insect cages, such as are employed by the Bureau of Entomology to protect plants from insect pests, and also of various kinds of shade cloth employed by tobacco growers in certain sections to improve the quality of the tobacco leaf. The shading may be expressed by a simple mathematical formula, as has been shown in the *REVIEW* for September, 1916.

The shade cloth is also used at the Arlington Farm by the Bureau of Plant Industry to determine the relation between sunlight intensity and the development of certain standard plants. In these investigations the solar radiation measurements for Washington, referred to above, are also utilized.

AGRICULTURAL METEOROLOGY.

The Division of Agricultural Meteorology was established February 21, 1916, for the purpose of conducting studies of every character of the relation of weather to crops and the collection of statistical data required in such studies, including the direction and supervision of cooperative relations with the State experiment stations and other contributing organizations. The division conducts investigations of the effect of weather and climate upon the growth and yield of crops, determines the distribution of frost warnings and forecasts for special agricultural interests, conducts studies for the protection of crops and orchards from frost, has general supervision over all special services and, in general, supervises the activities of the Weather Bureau which relate particularly to agriculture.

CORN AND WHEAT REGION SERVICE.

This service covers the 16 principal grain States, and its organization, as well as the service given, is indicated by the following table:

Region center (Chicago, Ill.)	1
District centers	13
Special reporting stations	189
Stations opened during year	21
Stations closed during year	9
Stations issuing daily corn and wheat region bulletin	18
Total number daily bulletins issued	2,964

This service has been improved during the year by the establishment of additional stations in the western grain districts. Also by the completion of arrangements for publishing a weekly corn and wheat region bulletin at the region center; the issue of these bulletins began the first part of July, 1917, with a list of approximately 600 addresses.

COTTON REGION SERVICE.

This service covers the principal cotton States, and its organization, as well as the service given, is indicated in the following table:

Region center (New Orleans)	1
District centers	13
Special reporting stations	167
Stations opened during year	2
Stations closed during year	0
Stations issuing daily cotton region bulletins	26
(In addition to this Galveston, Tex., publishes the cotton information on a large glass map.)	
Total number daily bulletins issued	2,358

As will be seen from the foregoing table this service was reorganized during the spring of 1917 by the establishment of a region center at New Orleans. The telegraphing of the district averages was discontinued, and in their place a summary is being telegraphed

from the region center to 26 different points and there published in the form of daily bulletins and given to the press; this information is also used at New Orleans in the same manner. Data covering the rainfall at each of the 167 stations, and temperature at 5 stations in each State are telegraphed to the region center, and after being tabulated and charted the summary mentioned above is prepared. In addition to the general weather conditions heavy rainfalls at individual stations are included.

SUGAR AND RICE REGION SERVICE.

This service covers the rice-growing region of Texas and Louisiana and the sugar-cane-growing sections of the South. The stations covering these crops are seven in number, and the information is published in the cotton region bulletins. The district center is at New Orleans.

CATTLE REGION SERVICE.

There is one district center, located at Amarillo, Tex., with 11 special stations covering this service; in addition to these, special reports are received from 20 other points in western Texas and Oklahoma. This cattle-region service covers southeastern Colorado and central and eastern New Mexico, in addition to western Texas and Oklahoma. A second cattle-region bulletin distributing point was established at Roswell, N. Mex., during the year. The number of daily bulletins published at these two points is 657. Preliminary steps are under way for the establishment of a new district center at Phoenix, Ariz., as well as at Salt Lake City, Utah.

CRANBERRY WARNING SERVICE.

Special cranberry-warning services are maintained in eastern Massachusetts, southern and northwestern Wisconsin, and central and southern New Jersey. Ten special stations are maintained in these districts, from which daily weather reports are sent to the forecast centers to aid in making frost and minimum-temperature forecasts.

SPECIAL FRUIT-WARNING SERVICE.

Special frost and minimum-temperature warning services, with special reporting stations, are maintained as follows:

<i>Center.</i>	<i>District covered.</i>
Columbus, Ohio.....	Most of State.
Medford, Oreg.....	Rogue River Valley, Oreg.
Walla Walla, Wash.....	Upper Columbia River Valley in Washington and Oregon.
Boise, Idaho.....	Boise-Payette district.
Do.....	Twin Falls district.
Salt Lake City, Utah.....	Northern Utah.
Delta, Colo.....	Gunnison River Valley.
Grand Junction, Colo.....	Grand River Valley.
Pueblo, Colo.....	Canon City, Colo., district.
El Paso, Tex.....	Rio Grande Valley.
Roswell, N. Mex.....	Pecos Valley.
Los Angeles, Cal.....	Southern California.
San Francisco, Cal.....	Central California.
Portland, Oreg.....	Salem, Oreg., vicinity of.
Jacksonville, Fla.....	Central and southern Florida.

Recent studies of methods for making more definite minimum-temperature forecasts, based on mathematical hygrometric and thermometric formulæ, have proved very helpful, and these studies will be continued. These local officials are studying the topographic and other conditions, and give expert information to those orchardists who are prepared to prevent frost damage by artificial means.

Special frost warnings are also distributed from a large number of Weather Bureau stations for fruit and truck interests, although no special station reports may be received.

ARTIFICIAL PROTECTION OF ORCHARDS, GARDENS, ETC., FROM FROST.

The service described in the preceding section has been maintained for many years. Beginning with the fiscal year July 1, 1917, Congress made available a special appropriation for the study of the efficiency of methods of artificially protecting orchards, gardens, etc. Preliminary preparations for the inauguration of this work were begun before the close of the year, in order to take advantage of the spring frosts of that season, and the work will be carried forward during the year with the appropriation available.

FROST AND TEMPERATURE STUDIES IN NORTH CAROLINA.

In 1912 the bureau inaugurated a study of the very interesting atmospheric phenomena and anomalous climatic features which have been designated thermal or frostless belts and verdant zones, and which are strikingly developed in some of the mountainous sections of western North Carolina.

The observational program of this project was brought to a completion December 31, 1916, with nearly five years of accumulated data from about 68 stations.

This project has been supervised by Prof. H. J. Cox, who is now engaged in the completion of his report, which will doubtless supply a much more comprehensive and detailed account of these climatic phenomena than ever heretofore attempted.

ALFALFA SEED-WARNING SERVICE.

A minimum-temperature forecast service is maintained at Salt Lake City, Utah, for the benefit of the alfalfa seed growers in central Utah. Four special reporting stations are in operation and the information from these is used as an aid in making the minimum temperature predictions. The plan of the seed growers is to leave their last stand of alfalfa for seed; if freezing temperature occurs while the matured or nearly matured plants are standing the seed is ruined; if the warning can be received a sufficient time in advance to cut the alfalfa, only the top layer will be damaged. The growers frequently run their mowing machines all night long preceding a dangerous temperature.

A similar service has been put into operation during the present season in western South Dakota, with Rapid City as the distributing point. No special stations have yet been established, however. This service is susceptible of expansion.

ALFALFA HARVEST SERVICE.

Special three- or four-day forecasts are being made for the benefit of the alfalfa growers throughout the whole western part of the country. Information of fair or rainy weather periods is telegraphed from the district centers to the large alfalfa-growing sections, to enable harvesters to cut and cure the alfalfa to best advantage.

POTATO FROST-WARNING SERVICE.

In the fall of 1916 special freezing-temperature forecasts were issued by the district forecaster at Denver for western, south-central, and north-central Colorado, at the request of the State Potato Growers' Association. These warnings are of value and will be continued.

RICE HARVEST FORECASTS.

A three- or four-day forecast, especially in connection with heavy rains, is sent from New Orleans to the rice growers in Arkansas.

SPECIAL STORM WARNINGS FOR SHEEP INTERESTS.

Special rain and temperature forecasts are made at Portland, Oreg., during the shearing and lambing season, for wide distribution in Oregon, Washington, and Idaho. This service fosters early shearing and lambing by enabling the ranchmen to keep the newly shorn sheep and young lambs near shelter when a cold storm is anticipated.

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REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY,
Washington, D. C., September 29, 1917.

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1917.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

MEETING THE FOOD AND WAR EMERGENCY.

The energies of the bureau have been directed especially toward the great national task of producing and conserving food and other needed supplies. Efforts have been made to stimulate the production of meat and dairy and poultry products, to utilize these foods in the most economical way, to suppress animal diseases, to make the wisest use of available feedstuffs for live stock, and to encourage the more general raising of farm animals. The regular work in these directions has been enlarged and more vigorously pushed, and new plans have been laid.

As hogs and poultry yield quickest returns, special campaigns have been begun to enlarge their production. The boys' and girls' pig and poultry clubs are being used as valuable agencies in this work. Some of the things advocated are the greater production of pigs in fall litters, the more extensive feeding of pigs on garbage, the raising of chickens on small premises and feeding them partly on table waste, and the more general production of infertile eggs after the hatching season so that spoilage may be avoided.

More careful and intelligent feeding is also being urged. While it is necessary that animals be well fed in order that large yields may be obtained, farmers are advised to feed a minimum of things needed for human food and a maximum of what would otherwise be waste products.

Sheep raising for both mutton and wool is being encouraged. Horse breeding is likewise advocated, to replenish the supply de-

pleted by military demands, and to provide needed work animals. Special efforts are under way to increase beef production. Stock owners are urged not to be led by high prices into selling their breeding stock, and aid is given in procuring and placing breeding animals.

It is evident that our main dependence must be placed on the farms for an increase in live-stock production, and the advantages of raising more animals are being pointed out to the general farmer. There is every evidence that the shortage of live stock and their products will continue for a considerable time after the close of the war, and that the farmer who enlarges his stock-raising operations is not only serving his country but is at the same time engaging in a profitable business enterprise.

Besides endeavoring to stimulate directly the production of live stock, the bureau has sought indirectly to increase production by combating animal diseases throughout the country in a more intensive way than ever before. The greater efforts in eradicating the southern cattle tick have resulted in the freeing of additional areas which are now open to successful cattle raising. The more active work against hog cholera has been rewarded by a marked decline in the prevalence of that plague and the placing of hog raising on a relatively safe basis in sections where losses usually have been heavy.

Campaigns for greater production and fuller utilization of milk and other dairy products also have been started. The work of the cow-testing associations enables the dairy farmer to feed his cows to better advantage and to get rid of those that do not give a good return for their feed.

The cottage-cheese propaganda is a good example of what has been and is being done to bring about the better utilization of food. It has been recommended that skim milk, which is often fed to pigs or thrown away, be made into cottage cheese, a wholesome and nutritious human food which may be used to replace meat to some extent in the diet. Directions for making the cheese in the factory, on the farm, and in the home, and recipes for its use, have been prepared and widely circulated. Already there has resulted a pronounced increase in the output and consumption of this cheese.

These things have been brought to the attention of the people by field agents, working usually in cooperation with other branches of the department and with State and local agencies; by personal conferences, addresses at meetings, cooperation with stockmen's and dairymen's organizations, and by preparing and issuing numerous publications and giving out information and advice through the department's information service and the press.

During the fiscal year 107 new publications, comprising 2,791 printed pages, were issued or contributed by the bureau. These included 11 Department Bulletins, 17 Farmers' Bulletins, 9 articles in the Journal of Agricultural Research, 12 articles for the Department Yearbook, 2 books for congressional distribution, 13 issues of Service and Regulatory Announcements, 25 miscellaneous pamphlets, and 18 orders in the nature of regulations. In addition numerous articles were furnished for the Weekly News Letter and to outside scientific and technical journals.

REORGANIZATION OF CERTAIN WORK.

The development and extension of some of the bureau's work made desirable certain changes in the organization, which were effected during the year.

The regulatory and inspection work in the enforcement of the virus-serum-toxin law of 1913, previously conducted along with the laboratory work jointly by the Pathological and Biochemic Divisions, was placed in a separate branch under the designation of Office of Virus-Serum Control with Dr. H. J. Shore in charge. This change took effect February 17, 1917. The divisions named continue the laboratory work such as the testing of samples, the Biochemic Division supervising tuberculin, mallein, anti-hog-cholera serum, and hog-cholera virus, and the Pathological Division other products.

The branch of the bureau carrying on the field work against hog cholera, under Dr. O. B. Hess, was given at the same time the title of Office of Hog-Cholera Control.

The work of the Field Inspection and Quarantine Divisions was rearranged and two new divisions were created. The changes took effect May 1, 1917, making the organization and duties as follows:

The Field Inspection Division, with Dr. A. W. Miller as chief, to have charge of the eradication of sheep scabies, cattle scabies, horse scabies, and dourine.

The Quarantine Division, with Dr. R. W. Hickman as chief, to have charge of the work relating to the importation and exportation of live stock, hides, skins, wool, hair, hay, straw, forage, etc.

The Tick Eradication Division, with Dr. R. A. Ramsay as chief, to have charge of the eradication of the southern cattle tick.

The Tuberculosis Eradication Division, with Dr. J. A. Kiernan as chief, to have charge of the field work relating to tuberculosis of animals, the interstate inspection of live stock at stockyards, and the administration of the 28-hour law.

CONTROL OF HOG CHOLERA.

Intensive work for the control of hog cholera was conducted in cooperation with the regulatory and educational State forces in selected counties in 14 States, as follows: Georgia, 7; Idaho, 11; Indiana, 35; Iowa, 28; Kansas, 14; Kentucky, 6; Michigan, 36; Missouri, 114; Nebraska, 8; Ohio, 6; Texas, 13; North Carolina, 6; South Dakota, 6; Virginia, 5; an increase during the year of 168 counties, making a total of 295 now included in the work. In addition to activities in these various districts, the services of bureau veterinarians have been available to county agents and other extension workers in other sections of the State requiring or desiring instruction and advice.

The results already obtained in the reduction of losses represent substantial savings to the swine industry of these States, and the success achieved in the control of hog cholera in these districts offers swine growers a degree of safety which has stimulated increased production in some sections.

A total of 343,822 hogs were treated in cooperation with and under the instruction of bureau veterinarians, the average loss in cholera-infected herds being limited to less than 13 per cent by the use of

anti-hog-cholera serum. Representatives of the department visited a total of 15,560 farms for the purpose of making investigations, diagnosing disease, and giving advice regarding control and eradication. Two thousand and fifty-six meetings were held, at which 100,190 farmers and others were present to receive information concerning regulations, quarantine, and measures necessary to combat cholera successfully. Two thousand two hundred and thirty-six farms on which the disease was found were either cleaned and disinfected or measures were taken to prevent the infection from reaching neighboring premises.

A special feature of the work of the year has been the successful efforts in enlisting the support and cooperation of practicing veterinarians in the control and suppression of hog cholera, resulting in uniform methods of treatment and moderate charges to farmers for professional services in this line of work.

State-wide educational and demonstrational work against hog cholera has been conducted in cooperation with the extension divisions of agricultural colleges in Alabama, Arkansas, California, Florida, Maryland, and Tennessee. In these States the activities of bureau veterinarians have been limited to lectures, demonstrations in the use of serum, general instructions to county agents, farmers, and swine growers on the subject of hog cholera, and taking part in campaigns arranged by the colleges to bring to the attention of farmers the possibility of reducing losses by the proper administration of serum. In some of these States work of this character has progressed to the point of action being taken to substitute intensive activities, supported by the regulatory authorities, for the control of the disease in restricted areas.

VIRUS-SERUM CONTROL.

The preparation and importation of viruses, serums, toxins, etc., for the treatment of domestic animals are supervised and regulated under the law of 1913. At the close of the fiscal year there were 89 firms licensed by the Secretary of Agriculture to maintain establishments for the preparation of such products for sale in interstate commerce, and 2 firms held permits for the importation of products prepared in 8 foreign laboratories. These licenses covered 135 different products. One license was suspended and two were revoked during the year.

Virus and serum for use in the prevention of hog cholera form a large part in volume of the products supervised. The anti-hog-cholera serum produced by licensed establishments during the year amounted to 238,861,279 cubic centimeters of which 5,036,875 cubic centimeters was destroyed by direction of bureau inspectors as being unfit for use. There was also prepared 68,813,983 cubic centimeters of hog-cholera virus for use in hyperimmunization of pigs for the production of serum and 8,847,196 cubic centimeters for use in conjunction with serum in preventive treatment. Of the former, 3,262,756 cubic centimeters was destroyed as being unsuitable for use, while 1,183,271 cubic centimeters of the latter was withheld from the market by the inspectors. To determine the purity of these products 1,064 tests of the virus and 2,167 tests of the serum were made on calves, and to determine the potency of the serum 3,642 tests were

made on pigs. For use in the preparation of these products 203,373 animals were inspected, 5,136 of which were rejected.

A number of the firms licensed for the production of hog-cholera virus and anti-hog-cholera serum have made arrangements to heat these products in accordance with methods worked out in the bureau laboratories, or by modification of such methods, and are now marketing clear, sterile virus and serum. The sterilization of these products is a distinct advantage, as it removes blood corpuscles and guards against contamination with the virus of foot-and-mouth disease or other diseases.

Several new products have come up for consideration during the year. Among them are blackleg filtrate, prepared from cultures of the blackleg bacillus on specially prepared medium, and a new form of blackleg vaccine often termed blackleg aggrassin, prepared from juices obtained from lesions of animals affected with blackleg.

VESICULAR STOMATITIS.

The event of greatest consequence during the year in the field of live-stock sanitation was the appearance among horses and cattle of a malady known as vesicular stomatitis. This was given peculiar significance by the spread of the affection among horses collected for exportation for military purposes and by its close resemblance to the dreaded foot-and-mouth disease, a very extensive outbreak of which had but recently been stamped out after a struggle of two and a half years.

In the early fall of 1916 reports were received from several sources to the effect that a disease involving the mouths and particularly the tongues of horses existed at the concentration remount station near Chicago, Ill. A careful and systematic investigation was immediately begun, which indicated that at this time the disease was confined solely to equines and that the infection could be traced back to similar remount stations at Grand Island, Nebr., and Denver, Colo. At these points horses and mules had been gathered together by agents of the French and British Governments for shipment abroad, and the disease found ideal conditions for its spread among the thousands of these animals closely quartered in barns and pens. As the disease was undoubtedly contagious, local quarantines were recommended and enforced. Sick animals were separated from the well, the healthy but exposed were held for eight days before being allowed shipment, infected pens were cleaned and disinfected, and the mouths of sick animals were thoroughly washed with a weak solution of permanganate of potash.

Several weeks later a livery barn in Chase County, Nebr., became infected as a result of the owner shipping a carload of horses to Denver for Army purposes and the return to the livery barn of several rejected horses. Three or four days later these rejected animals developed the disease, which spread to other horses and one cow in the livery barn. The disease was carried back to several ranches in that vicinity by the ranch horses which had been driven to town by their owners and fed and watered at this public livery barn. The disease now seems to have reached its most virulent stage, and having affected many of the horses on these ranches, it spread to a number

of cattle, but did not involve the hogs which were running in the same pastures.

The spread of the disease to the Chase County district was indirectly brought to the attention of the bureau late in November, when a shipment of cattle from that locality to the Kansas City stockyards was found by the bureau inspectors to be affected with lesions in the mouth strikingly similar to those of foot-and-mouth disease. All precautionary measures were immediately taken, outgoing shipments from the yards were stopped, the cars carrying cattle were located and disinfected, and the cattle were traced to their point of origin in western Nebraska. In the meantime experts were sent to the latter point as well as to Kansas City, and a series of careful and comprehensive experiments was immediately begun at those points and also at Washington. As a result of these tests and the reports from the field inspectors, the opinion was reached that the disease in question was not foot-and-mouth disease, but vesicular stomatitis, a contagious disease affecting the mouths of horses, but at times spreading to cattle also.

This affection is known in Europe and South Africa and has been observed occasionally in the United States, but without attracting any particular attention. The recent outbreak is the most extensive yet noted in this country, the disease having been especially prevalent in Nebraska, South Dakota, Colorado, and Wyoming. From the remount stations in the Central West it became distributed by following the channels of trade from the western markets eastward as far as the Atlantic coast. Several shipments of infected horses were made to France, where the disease was promptly detected and investigated by the French veterinarians.

The measures taken to combat the outbreak were soon effective, and the disease has now disappeared from the United States.

The most striking lesion of vesicular stomatitis is the occurrence of vesicles or blisters followed by erosions, chiefly on the tongue, but also involving other portions of the mouth and occasionally the muzzle.

No losses have been reported from uncomplicated cases of this disease in either horses, mules, or cattle. A certain proportion of horses and mules having vesicular stomatitis also became infected with either influenza or contagious pneumonia, or perhaps both, and a number of deaths occurred among such animals.

That the malady is contagious has been definitely shown by the transmission of the disease from sick to healthy animals by inoculation. The degree of contagiousness, however, varies between wide limits. As a rule the disease appears to be spread by direct contact with recently affected animals or with recently infected feed troughs, water troughs, bridles, or pails. Investigations indicate that the disease is very seldom communicated by owners or caretakers of affected animals visiting other farms.

Investigations so far have not resulted in identifying any particular organism as the cause of the disease. The contagion is evidently contained in the fluid of the blisters and is most virulent at the time the blisters rupture or shortly thereafter, disappearing usually after five or six days.

While vesicular stomatitis has not the great economic importance of foot-and-mouth disease, it nevertheless is contagious and causes

considerable alarm, owing to its close resemblance to that disease. Furthermore, as most writers state, this infection in cattle may be readily confounded with foot-and-mouth disease, and experience has shown that a prompt and exact differentiation is accompanied by numerous difficulties.

The principal differences between the two maladies may be stated as follows: Horses are especially subject to vesicular stomatitis, but have not been observed to contract foot-and-mouth disease in outbreaks of the latter in the United States. Hogs and sheep, on the other hand, are susceptible to foot-and-mouth disease, but have not been observed to contract vesicular stomatitis under natural conditions. Foot-and-mouth disease, once introduced, quickly affects practically 100 per cent of the cattle and hogs on a farm, while vesicular stomatitis spreads to a much smaller proportion of the cattle and is not readily transmitted except by immediate contact. Certain differences in the symptoms and lesions of the two diseases have also been noted.

The real difficulties surrounding the diagnosis are best appreciated by those who have faced them with the consciousness that their pronouncement if mistaken would lead on one hand to unnecessary and serious economic disturbances and on the other to the spread of one of the most dreaded and easily communicated among animal plagues. Vesicular stomatitis will therefore prove a menace whenever and wherever it may reappear. For these reasons it is strongly urged that local quarantines to prevent its spread be imposed by State live-stock officials in whose territory the disease may be found. All owners and handlers of horses, mules, and cattle, particularly liverymen, managers of stockyards, and stockmen, should be directed to separate sick from well animals, clean and disinfect contaminated premises, and have all infected animals appropriately treated.

ANIMAL HUSBANDRY DIVISION.

GEORGE M. ROMMEL, *Chief*.

ANIMAL HUSBANDRY EXPERIMENT FARM.

The work at the experiment farm of the bureau used by the Animal Husbandry Division, at Beltsville, Md., has been continued as heretofore. Work has been done in the construction of sewers, the laying of tile drains, and the improvement of the farm roads. The hog house was equipped with individual feeding pens and the small-animal breeding laboratory was remodeled and greatly improved. An entrance gateway was erected at the main farm entrance, and a contract was let for the construction of a barn to replace the sheep barn destroyed by fire two years ago.

ANIMAL GENETICS.

The study of inbreeding continues to be the main subject of investigation in the work on animal genetics. At present 15 families of guinea pigs are being used, which trace back by exclusively brother and sister matings to 15 original pairs. Some are in the seventeenth

generation of inbreeding. The effects of crossbreeding between different inbred families is also being studied extensively, and a stock of normally bred guinea pigs has long been maintained as a control.

The most certain effect of inbreeding has been found to be the tendency toward uniformity within each inbred stock, with the resulting differentiation between different stocks. This differentiation can not be put on a basis merely of high or low vigor. In a given family vigor in one respect may be associated with lack of vigor in another. It is, however, true that the inbred stocks have all shown a decline from their original condition in most respects. An appreciable return of vigor takes place on crossing different inbred lines. There are, however, indications that the decline is not so much a necessary as merely a likely result of inbreeding, as of any other rigid system of mating.

A series of papers has been prepared for the Journal of Heredity, reviewing the present knowledge of inheritance of coat color in mammals.

BEEF CATTLE INVESTIGATIONS.

BEEF PRODUCTION.

The experimental cattle-feeding work in Mississippi, North Carolina, and West Virginia, in cooperation with the State agricultural colleges, was continued.

At Canton, Miss., a duplicate of the previous year's work was done with three carload lots of steers. A comparison was made of cottonseed meal with silage as the sole roughage and in combination with corn stover and oat straw. The results of the two years' work showed no advantage in the addition of corn stover or oat straw to silage. Twenty calves from the breeding herd were fattened for records on cost of production.

At Abbott, Miss., three lots of steers were fed, testing the efficiency of cottonseed meal alone as compared with a combination of cottonseed meal and corn, the roughage for each lot being the same. This was a duplication of the previous year's work. The results indicated that cottonseed meal alone was the most economical ration. Two lots of short-aged calves were fed to determine if it would be profitable to finish them the following year, and also to compare the efficiency of cottonseed meal alone and in combination with corn. The results indicated that good profits could be made with such calves and that cottonseed meal was the most economical ration.

At Springdale, N. C., three lots of steers and one of calves were fed in testing different methods of wintering. The cost of wintering on pasture was \$7 a head less than the common method of wintering on ear corn and hay, and the cattle were in better condition in the spring. The use of silage was also much more economical than the common method.

At Lewisburg, W. Va., three lots of yearling steers and three lots of calves were wintered, testing the use of silage instead of the common ration of hay and straw. Silage proved to be most economical for both steers and calves.

CATTLE BREEDING.

At each of the cooperative experiment stations the breeding herds were maintained and the work carried on the same as in the preceding year.

The cooperative Shorthorn cattle breeding work at the Kansas Agricultural College was carried on as previously planned by the Bureau of Animal Industry and the Kansas Agricultural College, as outlined in last year's report.

SWINE INVESTIGATIONS.

The work in pork production at the Beltsville farm deals mainly with feeding swine, though enough attention is given to breeding to obtain the best animals possible under a system of grade breeding for use in the feeding tests.

Experiments in cooperation with the Bureaus of Chemistry and Plant Industry to study the value of dried pressed potato and potato silage as a feed for pigs have been completed and a paper reporting this work has been submitted for publication. Experiments are in progress to determine the relative value of certain forage crops for growing pigs. The economy of the self-feeder in the dry lot and on pastures is being studied. The experiments to determine the effects of cottonseed meal when fed to pigs have been discontinued for the present.

An experiment to determine the value of a mineral mixture as a preventive against worms when fed to pigs was conducted in cooperation with the Zoological Division. Results will show no positive evidence that a mixture will prevent worm infestation.

With the idea that there is an opportunity for better utilization of city garbage by feeding it to hogs, thus giving back to the city a supply of food in the form of pork and at the same time giving to the cities a more economical and efficient method of garbage disposal, as well as opening to interested persons a source of reliable information on how to proceed in the development and maintenance of this business, the division began the study of this problem. A representative made an inspection trip throughout the New England and Middle Atlantic States to study the feeding of garbage to hogs. A paper embodying the latest information on the subject, based largely on the observations of the division's representative in the field, has been prepared and submitted for publication.

SHEEP AND GOAT INVESTIGATIONS.

A summary of nine years' records in range sheep breeding investigation shows the following results: Non-lambing 2-year-old ewes are subsequently just as dependable as breeders as those that produce lambs the first time bred. Grade Rambouillet range ewes produce the greatest grease weights of wool at 4 years of age, and the lamb yield increases slightly from 3 to 6 years of age. Ewes having heavy skin folds over the body yield larger weights of grease wool of less length than plain-bodied ewes, though the actual weight of clean wool is not known to be greater. Fleeces of 56's and 58's quality from grade Rambouillet ewes show greater length than those of finer quality. The lambs from imported Corriedale rams and ewes appear equally as hardy under Wyoming conditions as native stock, and

stock sired by Corriedale rams from native cross-bred ewes are of good build and very uniform in all respects.

The first year's test did not show material increase in the number of lambs from Southdown ewes that received extra feed at mating time. Twin-born lambs raised as singles (having all of one ewe's milk) attained the same weight as single-born lambs.

The educational wool car used in the field last year was again circulated this year in cooperation with the agricultural colleges of Colorado, Wyoming, Idaho, Montana, Oregon, and Washington. This collection, together with the motion-picture film showing the manufacturing steps from raw wool to finished cloth, proved of great interest at each of 60 towns in the States mentioned. At each point large numbers of sheep raisers visited the car, and in a number of cases the local authorities made arrangements for the school children to see the pictures.

In experiments in cooperation with the New York City Department of Health to see if goat's milk has any special value for tubercular patients, this milk when used for adolescent tubercular patients has not proved more valuable than cow's milk. Cheese made from goat's milk by the Dairy Division "has some of the characteristics of Camembert and would probably find a ready market."

HORSE AND MULE INVESTIGATIONS.

BREEDING AMERICAN CARRIAGE HORSES.

Work in the horse-breeding investigations carried on in cooperation with the Colorado Experiment Station has progressed very favorably. The foals being produced show good uniformity. The stud is now composed almost entirely of animals produced in the experiment, and they all possess to a large degree the desired type. The 24 brood mares produced 17 foals during the year. The stallions Defender and Highball are standing for public service at Shell, Wyo., and Montrose, Colo., respectively.

As recommended by the board of survey, 22 animals were eliminated from the experiment as unsuitable to be retained for breeding purposes. The brood mare Bonita and a weanling died during the year.

For the past two years approximately one-half of the brood mares have been fed on alfalfa hay during the winter and pastured on alfalfa during the summer. The other brood mares have been fed on native hay and grain and pastured on native grass pasture. No ill effects have been noticed from the alfalfa feeding. Care has been taken not to overfeed and not to feed any dusty or damaged alfalfa hay.

BREEDING MORGAN HORSES.

At the close of the fiscal year there were in use at the Morgan horse farm, near Middlebury, Vt., 12 mature stallions, 6 young stallions, and 31 mares, 19 of which are mature. The 19 mares bred, in 1916 have produced 9 foals, and 6 mares are yet to foal. Two stallions from the farm are standing for public service in North Carolina. Five of the stallions from the farm are standing in the eastern part of Vermont for the purpose of producing horses suitable for military use.

BREEDING HORSES FOR MILITARY PURPOSES.

In the breeding of horses for military purposes the 2,150 mares bred in 1915 produced 948 living foals in 1916. During the calendar year 1916, 2,022 mares were bred to the 36 stallions used in this work, and 717 living foals were reported up to June 30, 1917. During the first half of 1917, 1,448 mares were bred to the 35 stallions used.

The first extensive purchases by the Army of 3-year-olds bred under this plan were made during April and May, 1917.

BREEDING HORSES ON INDIAN RESERVATIONS.

During the calendar year 1916, 454 mares were bred to the 8 stallions maintained under this project with headquarters at Eagle Butte, S. Dak. Two hundred and twelve of these mares were bred to the four Percheron stallions, or an average of 53 per stallion; 127 to the two Saddle stallions, an average of 63½ per stallion; and 115 to the two Standardbred stallions, an average of 57½ per stallion. The 426 mares bred in 1915 produced approximately 275 foals.

COTTONSEED MEAL FOR FARM WORK STOCK.

Feeding tests with four mules and one mare were conducted for the purpose of studying cottonseed meal as a feed for farm work stock and for a comparison of cottonseed meal and linseed-oil meal for such animals. The tests were too short to be conclusive, but as the animals lost in weight and condition and showed a pronounced dislike for the meal in the quantities fed as a regular part of the ration, the results seem to enforce the idea that a protein concentrate should be fed only in limited quantities. Further experiments are desirable, however, before drawing positive conclusions regarding the value of this feed for work stock.

ANIMAL HUSBANDRY EXTENSION WORK.

A new policy of great importance in the conduct of the extension work carried on by the Animal Husbandry Division was adopted during the fiscal year, resulting in the drawing up of four new projects with the States Relations Service, two with each of the extension offices of that service. The essence of the plan is that the States Relations Service will look to the Animal Husbandry Division for technical information, which division will be responsible for such technical information on animal and poultry husbandry as is given out by the States Relations Service. The States Relations Service, on the other hand, will be responsible for matters of policy and procedure which relate purely to technical States Relations subjects. Offices of animal-husbandry extension and poultry-husbandry extension have been established in the Animal Husbandry Division. The men in charge of this work have their salaries paid by the Bureau of Animal Industry and their traveling expenses by the States Relations Service. When they travel in the field they are representatives of the department in the broadest sense, representing the Bureau of Animal Industry on subjects relating to animal or poultry husbandry and the States Relations Service on all subjects of a purely States relation character. This plan has developed the most har-

monious and cordial relations between the offices concerned, and is believed to be a happy solution of a very important problem in the department's extension work.

PIG CLUBS.

During the year 13 specialists in as many States supervised the work of 21,673 members of boys' and girls' pig clubs, which is an increase of 96 per cent over the membership of preceding years. This work was carried on in the States of Alabama, Arkansas, California, Georgia, Indiana, Kentucky, Louisiana, Massachusetts, Nebraska, North Carolina, Oklahoma, Oregon, and Texas. The number of members reporting showed an increase of 148 per cent. The present membership is nearly 30,000. Records on over 6,000 pigs show an average daily gain in weight of 1.044 pounds at a cost of 5.12 cents a pound. The members average 13.7 years of age. Seventy per cent of the members have pure-bred pigs, and 69 per cent are using pasture or grazing crops. A shortage in the supply of available pigs is a limiting factor in nearly every State.

Financial aid by bankers plays an important part in the success of this work. Last year bankers in Arkansas, for instance, furnished pure-bred pigs (most of them gilts) to 1,800 of the 2,100 pig club members on 6 per cent interest-bearing notes. The notes run from 12 to 15 months, so that members may pay for the original gilt from her produce.

The pig clubs are influencing meat production, as is indicated by the plans in several States to have clubs in various counties send a carload of fat hogs each to the State fair or fat-stock show to compete for prizes, then to be marketed cooperatively. Good attention is given to breeding, as is shown by a boy winning first in a class at the National Swine Show and selling his winning gilt for \$250.

BEEF CATTLE EXTENSION WORK.

Field agents in the beef cattle extension work gave specific advice to 5,300 farmers and addressed 539 meetings, with an attendance of 58,786 people. They were instrumental in bringing in and placing with farmers 2,991 breeding cattle, besides 960 hogs and a number of mares for breeding purposes, and also brought in 1,432 feeder cattle.

Fifty-eight baby-beef demonstrations, including 1,109 animals, and 150 steer-feeding demonstrations, using 5,517 head, were supervised. Direct assistance was rendered in building 58 silos. Forty-two pasture demonstrations for cattle and over 1,000 for hogs were made. Twenty-five additional live-stock organizations were formed. At a meeting of one of these associations, at Amarillo, Tex., 36,000 head of cattle were sold.

POULTRY INVESTIGATIONS.

FARM POULTRY INVESTIGATIONS.

The poultry-breeding experiments at the Beltsville farm have been continued along the following lines:

About 600 pullets, as well as hens 2, 3, and 4 years old, have been trap-nested, and about 60 matings made to continue the study and to

accumulate data with respect to egg production and the method of transmission of this quality of offspring.

The breeding up of flocks of mongrel hens by the use of pure-bred White and Barred Plymouth Rock males is in its second year. There has been a marked improvement in uniformity of the offspring.

Encouraging progress has been made in the establishment of a new breed having white plumage, four toes, yellow legs, red ear lobes, a body considerably larger than the Leghorn, and laying a white egg. About 2,000 chickens from the various matings are being reared with which to continue the different lines of work.

Nine new pens of fowls, making 20 in all, have been added to the feeding tests. Rations which have given the best results are being repeated, and new rations containing a much wider variety of feeds are being tested. Department of Agriculture Bulletin 561, "Feed Cost of Egg Production," giving the results of three years' feeding experiments, has been issued. A ration without wheat or wheat products fed to Leghorn pullets gave an average annual production of 147.3 eggs. Cottonseed meal used to replace half the beef scrap in the mash has given good results and has had no bad effect on the quality of the eggs. Where cottonseed meal replaced all the beef scrap the results were unsatisfactory, both in number and quality of eggs. Mussel meal has not proved as good a substitute for beef scrap as fish meal. Fish meal to the amount of 25 per cent of the mash has not affected the flavor or the taste of the eggs.

PIGEON AND SQUAB INVESTIGATIONS.

In the pigeon and squab investigations data are being accumulated on the cost of feeding squabs and stock birds of several different breeds. Various pure and cross matings have been made for the purpose of making further studies in feeding and breeding.

OSTRICH INVESTIGATIONS.

The ostrich investigations at Glendale, Ariz., in cooperation with the Arizona Ostrich Breeders' Association, are being continued for the purpose of improving the quality and increasing the yield of feathers. Crosses have been made between the Nubian and the South African birds, and a pair of Somali ostriches have been added to the department flock.

TURKEY AND GUINEA INVESTIGATIONS.

During the last spring a study was made of the possibility of raising turkeys in large numbers in the dry sections of the Southwest. Farmers' Bulletins 791, "Turkey Raising," and 858, "The Guinea Fowl," were prepared and published.

POULTRY HUSBANDRY EXTENSION WORK.

The improvement of farm eggs and the reduction of waste from spoiled eggs depends largely upon the production of infertile eggs. The bureau is therefore planning a much wider distribution throughout the country of the infertile egg placard, which has proved so effective.

A campaign was begun in the spring to encourage the early hatching of chickens in order to obtain better egg production during the fall and winter, and this will be continued on a larger scale during the coming year.

POULTRY CLUBS.

The girls' and boys' poultry clubs, first organized in 1912, are being continued in 8 States (Georgia, Kentucky, Massachusetts, North Carolina, Oklahoma, South Carolina, Tennessee, and Virginia), with a total of 249 counties organized, 1,121 clubs, and 11,224 members. During the past year members set 84,171 eggs, hatched over 59,000 chicks, and raised 38,327 matured fowls. More than \$8,000 worth of poultry products were sold or consumed at home. Those members who sent in full reports showed total receipts and value of stock on hand amounting to \$39,546.25, with an average profit over all expenditures of \$14.72 for each member so reporting. During the past year 129 exhibits were held, in which 1,649 members competed, showing 6,280 fowls and 329 dozen of eggs and winning prizes amounting to \$4,685.90. Poultry short courses have been established at many State schools and colleges as prizes to club members who have shown special excellence in their work.

COMMUNITY POULTRY BREEDING.

The establishment of community poultry breeding associations illustrates the interest being taken by the older people as an outgrowth of the children's work. The effect of these associations is to establish in one section an interest in one particular breed or variety of fowl. This work has been taken up in 4 States, with 42 associations and 885 members. One association devoted to Barred Plymouth Rocks did a business during the first five months of its existence amounting to \$7,500. Reports from members show that they have on hand 6,000 Barred Plymouth Rock hens and pullets and have marketed 1,000 capons. In 17 counties of one State over 83,500 eggs from standard-bred fowls have been distributed among the members of these associations for hatching.

EXPERIMENTS IN LIVE STOCK PRODUCTION IN SEMIARID AND IRRIGATED DISTRICTS.

The experimental work in the production of live stock in semi-arid and irrigated districts, begun during the past fiscal year, is carried on in cooperation with the Bureau of Plant Industry and under the general direction of the committee of five appointed by the Secretary of Agriculture for that purpose. The State experiment stations of Nebraska and Montana are also cooperating in the work.

A brief survey was made of several reclamation projects and the Bureau of Plant Industry stations located thereon, and of dry-land stations in the Great Plains region. Experimental work was begun at Bureau of Plant Industry stations at Huntley, Mont.; Newell, S. Dak.; Mitchell, Nebr.; and Ardmore, S. Dak. The Huntley and Newell stations were each equipped with stock, individual hog houses, and a large community hog house, fences, etc., needed to conduct work with hogs. No additional equipment was needed at the Mitchell station this year. At the Ardmore station a large com-

munity hog house was built, 450 acres of range fenced for pasturing beef cattle, and material and equipment purchased for a beef-cattle shed and a silo. Experiments with hogs and sheep were started in the spring of 1917 at the Huntley, Newell, and Mitchell stations. A beef-cattle pasture experiment is in progress at the Ardmore station. The bureau has trained live-stock men in charge at Huntley and Newell. At the Mitchell station the Nebraska State experiment station is maintaining a man in charge of the live stock.

An experiment in turkey production is being carried out at Fallon, Nev., at the station of the Bureau of Plant Industry at that point.

CERTIFICATION OF ANIMALS IMPORTED FOR BREEDING PURPOSES.

Under the provisions of paragraph 397 of the tariff act of October 3, 1913, the bureau issued, during the fiscal year, certificates of pure breeding for 747 horses, 556 dogs, and 14 cats imported for breeding purposes.

DAIRY DIVISION.

B. H. RAWL, *Chief*.

Dairying was before the public last year in a more vital manner than ever before. Because of the large place held by dairy products in food economy, efforts were made to insure an adequate supply by the elimination of waste, the more complete utilization of by-products, and by advising producers as to ways and means of meeting the high cost of feed without sacrificing their dairy cows.

Substantial development has been made in the various lines of extension. Progress in community effort, as exemplified by cow-testing and bull associations, has been particularly noteworthy in the newer dairy sections of the Southern and Western States. In many sections of those States creameries and cheese factories have afforded excellent opportunities for dairy development, which are quickly being taken advantage of by the farmers. In the older settled sections of the Eastern and Middle Western States efforts have been directed toward more efficient operation for both farm and factory. In the efforts to improve the milk supply the efficacy of a few simple factors which can be applied without great expense has been demonstrated. The work upon research problems has yielded good results.

DAIRY FARMING INVESTIGATIONS.

SOUTHERN DAIRYING.

As a part of the continued work for the development of dairying in the South, an active campaign for feed production was carried on, with the result that a marked increase in the acreage of legumes, particularly velvet beans and peanuts, has been provided for dairy cattle. An effort was also made to introduce among the landlords a plan for making dairy cows an integral part of the farm equipment, which would enable the tenant to become self-supporting throughout the year and at the same time would maintain desirable soil conditions.

The introduction of dairy cattle has become very important in connection with the growth of the dairy industry in the South. Every effort is being made on the part of the field men to aid in bringing in a sufficient number of good cows so that dairying may become well established and the type of good cows be well fixed in the minds of the farmers. The readiness of bankers to finance farmers in the purchase of dairy cattle shows how well established the industry has become following the Federal and State work of recent years.

Boys' and girls' calf clubs are receiving considerable attention and encouragement.

WESTERN DAIRY WORK.

Assistance was given in the formation of 14 dairy organizations other than cow-testing or bull associations and a monthly news letter was published giving items of interest and helpful suggestions to the various field men in the territory. The local papers were furnished with 414 press articles and one entire edition of a farm newspaper was devoted to cow-testing-association work. Because of the scarcity and high prices of feed the dairy industry in the West did not increase so rapidly as during the preceding few years. These conditions and the Dairy Division's work, however, have led the dairymen to give more attention to keeping individual cow records, to cull out the low producers, and to prepare for the coming winter feeding period.

COW-TESTING ASSOCIATIONS.

Cow-testing associations, the organization and operation of which are encouraged and supervised by the Dairy Division, have continued to grow in numbers and results. There are now 472 active associations composed of 12,088 dairymen owning 216,831 cows. This is a net gain of 37 per cent in the number of associations as compared with the preceding year, and the cows tested are approximately 1 per cent of all the dairy cows in the United States. In four States associations were established for the first time, making a total of 37 States where active organization now exists.

The most noticeable development has been in the Western States, although there have been encouraging gains in other sections, particularly in the South where the work is new. An important feature of the work in the Western States is the employment of agricultural-college graduates as testers, these men being willing to accept low salaries because of the valuable training that they receive in the work.

BULL ASSOCIATIONS.

At the end of the fiscal year there were 36 active bull associations in 17 States with a total membership of 1,158 farmers owning 189 pure-bred bulls. These associations are organized for the joint ownership, use, and exchange of high-class, pure-bred bulls. A few examples illustrate the economic and constructive results of this work.

A Maryland association that began six years ago with one breeding block and one bull has now grown to 8 blocks and 11 bulls. Of the 17 producing daughters of association bulls 16 excelled their

dams. The average butter-fat production of the dams was 237 pounds, while the daughters produced 299 pounds, or 26.2 per cent more than their dams.

An association in Massachusetts has developed from a group of skeptical farmers into a vigorous and enthusiastic organization. In South Carolina a whole community has developed from a section in which dairy cows were rarely found and poorly maintained into one in which dairying is an established industry. The 42 members of the association have increased the number of their cows until they now own 310 divided into 4 breeding blocks. They have also added a number of pure-bred cows and heifers to their herds.

Bull associations have been a potent factor in the control of contagious diseases. One association has discarded all cattle reacting to the tuberculin test, while many associations have successfully avoided contagious and infectious diseases of all kinds.

COMMUNITY DEVELOPMENT IN DAIRYING.

Exceptional results have been accomplished in the community development work at Grove City, Pa. Patrons of the creamery quickly recognized the great opportunities for improvement and cooperated heartily with the field men in every way. Cordial cooperative relations have been maintained with the Mercer County farm bureau and county agent, the Grove City Commercial Club, and the Grove City National Bank.

In the line of dairy-farm improvement in that neighborhood, 18 silos, 9 of which are of brick or hollow tile, have been constructed, 18 barns built and 47 remodeled, and 9 milk houses built. All patrons are showing a tendency to improve the sanitary conditions under which milk and cream are handled and to install dairy conveniences.

As an outgrowth of the cow-testing club, begun a year ago, a cow-testing association of 35 members, owning 430 cows, was organized in June, 1917. Two bull associations were organized in December, 1916—a Jersey association with 32 members owning 240 cows, and a Holstein-Friesian association with 19 members owning 200 cows; and bulls of excellent quality have been purchased by these organizations. Another association to represent and promote the Guernsey breed has also been organized, but because of the distance between members the bulls are not owned cooperatively. A creamery association has been formed to look after the interests of the creamery patrons, and through this organization feed has been purchased cooperatively at considerable saving to the members.

In order to interest the young people in dairy work and to train them in the care and handling of dairy cattle, a boys' and girls' pure-bred cattle club was organized in April, 1917, with about 50 members. Each member arranged through the Grove City National Bank to buy and care for one calf. The club plan provides for the keeping of records of production as soon as the calves mature and begin to produce milk.

A gratifying feature of the work has been the introduction of 193 pure-bred females and 41 pure-bred bulls. A large percentage of the animals went to farms where no pure-bred stock had ever been

kept; in fact, 95 pure-bred herds were established around Grove City during the year.

DAIRY DEMONSTRATION FARM, DENISON, TEX.

The farm near Denison, Tex., owned by a company of local business men and managed by a specialist of the Dairy Division, which was bought some years ago for the purpose of demonstrating the possibilities of dairying on worn-out cotton land, showed a considerable increase in gross income during the past year, due in part to a better system of marketing. A reduction was made in the dairy herd in order that the field crops may fully feed the cattle.

HOLSTEIN-FRIESIAN BREEDING CIRCUIT IN NORTH DAKOTA.

The experiment with a Holstein-Friesian breeding circuit in North Dakota, begun in 1908, has been completed and the department's financial assistance terminated. At first this was a community project to demonstrate the effect of developing one breed of dairy cattle. A single breed of dairy cattle was established, herd-record keeping was introduced, and meritorious bulls brought in. The members have made arrangements to continue the work for another 10 years.

DAIRY RESEARCH LABORATORIES.

Much of the research work is of a fundamental character and applies to other industries as well as dairying. This is true of the work on hydrogen-ion concentration, which involves the synthesis of new dyes, and also the study of the molds concerned in the ripening of Camembert cheese. With certain molds it was found possible so to adjust the conditions of growth that practically all the sugar of a 10 per cent solution was converted into citric acid. This promises to be of great economic value, since it makes possible the manufacture, in this country, of citric acid, the entire supply of which is now imported. This acid is much used in tanning, dyeing, and other industries. A great deal of information has been obtained also regarding the classification and origin of the colon-aerogenes group of bacteria. Because of its presence being an indication of fecal contamination, this group is of special sanitary significance. The results obtained have been incorporated in official methods of water analysis.

EFFECT OF SILAGE ON CEMENT.

The use of concrete for silos has been criticized because of the supposed injurious effect of acids upon cement. Careful investigations have been carried on with oil-mixed concrete and with ordinary concrete coated with oil, tar, tar dissolved in gasoline, and cement wash. When in direct contact with silage both mixtures of concrete were slightly affected.

PHOSPHORUS AND CALCIUM IN MILK SECRETION.

In the studies of the relation of phosphorus and calcium to milk secretion considerable progress has been made, which, being of a

fundamental nature, promises to be of practical value in dairy-cattle feeding problems. Results so far obtained point to a satisfactory explanation of the method by which phosphorus and calcium are transferred from the blood to the milk.

FACTORS IN PRODUCING CLEAN MILK.

Extensive and careful experiments showed the following four factors to be of major importance in the production of milk containing small numbers of bacteria: (1) Thorough sterilization of milk utensils; (2) cleanliness of cows, especially of udders and teats; (3) the use of the small-top milk pail; (4) prompt and proper refrigeration. All those factors, as well as the health of the cows and of the attendants and the personal cleanliness of those who handle the product, are essential in the production of milk suitable for human food.

SWISS CHEESE.

Though for many years cheese of the Swiss type has been made in the United States, this domestic cheese sells for much less than the imported, largely because of the imperfect formation of the holes, or "eyes." The investigations to discover the organism that causes the eye formation have been continued with the expectation that it will be possible to develop a pure culture that will bring the commercial manufacture of Swiss cheese under absolute control. At present cheese closely resembling the imported is made with certainty by the use of mixed cultures.

SOFT CHEESE.

Simple methods for making cream cheese and Neufchâtel cheese have been developed and already have been put into successful operation. The Neufchâtel group, particularly because they require no ripening and but little equipment, are well adapted for manufacture on a small scale and frequently furnish a profitable market for milk.

BY-PRODUCTS.

The creamery at Grove City, Pa., because it is operated by the Dairy Division, furnishes equipment and makes possible studies in the economical utilization of by-products on a large scale. One of the most important results accomplished was the working out of a method for making high-grade cottage cheese from a mixture of skim milk and buttermilk.

Because of the failure of imports, casein, an essential in the making of paper, has been in great demand. While the best grade of casein is made from skim milk, it has been possible by the use of improved methods and equipment to make from buttermilk a quality that is but slightly inferior to the best grades of skim-milk casein. In fact buttermilk casein made at Grove City readily sold at only a cent or two below the highest grade of the domestic skim-milk product, and the manufacturers of paper prefer it to the poorer grades made from skim milk.

A study was also made of the economical utilization of skim milk by condensing. Bulk-evaporated, bulk-sweetened, and case-sweet-

ened condensed skim milk were manufactured and careful records kept, so that figures are now available as to the relative profits from all those products.

DAIRY MANUFACTURING INVESTIGATIONS.

CREAMERY MANAGEMENT.

So well established is the creamery industry that, except in the South, all energies of the Dairy Division with regard to that industry have been directed toward increasing the efficiency of operation and improving the quality of butter manufactured. Assistance has been rendered in many ways, especially in the prevention of waste and in the conservation of fuel.

On account of the rapid advance in the price of fuel the increasing of power and fuel efficiency in creameries was particularly opportune. Slight repairs to the engine in one creamery in Minnesota effected a saving of 10 per cent in the cost of fuel, and similar work at another in the same State reduced the fuel bill \$915, or 57 per cent of the total, as compared with that of the preceding year. Operating expenses were greatly reduced by substituting electric motors for steam engines in five creameries in Iowa and Minnesota in localities where electric power was available at low cost.

Where steam power is used, one great source of loss is the failure to make use of the exhaust steam from the engine. With proper equipment this steam can be used to heat the large quantities of water which are needed daily for pasteurizing cream and for cleaning equipment and floors. In order to utilize steam that would otherwise be wasted, 61 creameries in Minnesota and Wisconsin were assisted in obtaining or installing exhaust-steam water heaters. In a creamery of average size the use of a heater of that kind reduces the fuel bill from \$100 to \$200 a year.

CREAMERY DEVELOPMENT IN THE SOUTH.

The development of creamery work in the Southern States has been gradual but progressive. The creameries in the seven States where field men are cooperatively employed now number 112, a net gain of about 20 per cent in a year. Communities were encouraged to organize creameries when conditions were favorable.

Thirty-four of the creameries, in accordance with advice of the Dairy Division, pasteurize all cream for buttermaking. This practice has caused a marked improvement in the quality of the butter and has greatly increased market demands, at prices considerably above those formerly received. Sixteen of the 19 creameries in Mississippi were assisted in establishing a system of grading cream, with payment arranged on a quality basis. While the grading system has just been begun, it has already brought the patrons much higher prices for their cream.

CREAMERY WORK IN THE WEST.

Considerable progress was made in the standardization of butter manufactured in Western States. Through the organization of the Oregon Cooperative Dairy Exchange, which includes 20 cooperative

creameries in that State, there was great improvement in the uniformity and quality of butter marketed. Butter-scoring contests held in connection with the Western Dairy Products Show have also helped in standardizing and improving the product of the creameries in seven Western States.

CHEESE FACTORIES IN THE SOUTH.

In the mountainous sections of the South efforts have been made to increase cheese production, and the establishment of cheese factories has been encouraged in those regions where climatic and other conditions render their operations feasible. The work is necessarily limited to districts where the summer nights are cool and cold water is abundant.

Work was begun in September, 1914, when the first cheese factory was built in North Carolina. At that time a cheese expert was assigned to that region, and since then factories have been increasing rapidly. At present there are 34 cheese factories in the southern mountains, of which 20 are in North Carolina, 9 in Virginia, 4 in Tennessee, and 1 in West Virginia. Twenty-six were organized during the last year.

Every factory established has been successful and has shown a rapid growth from the day it opened. The cheese factories furnish outlets for milk in localities far distant from railroads and centers of population, and in that way have proved of great benefit to isolated regions. More requests for help have come from promising localities than can be attended to by the men now in the field. In 1916 the mountainous region of North Carolina alone produced \$30,000 worth of cheese, and the output for 1917 is estimated at \$100,000, of which \$75,000 will be newly created wealth.

CHEESE WORK IN THE WEST.

The western cheese work, begun in July, 1916, with one specialist in the field, has resulted in 12 new cheese factories. By improving the milk supply of these and other factories a better quality of cheese was produced and greater yields obtained. One factory has already reported that the improvement of the milk supply alone increased the net income from the cheese at least \$3,000 a year. The possibilities for the expansion of cheese work in the West are almost without limit, yet care is being taken not to encourage the establishment of factories where there are not cows enough or where other circumstances would prevent successful operation. The cheese from Idaho factories is now of such a uniform quality that it is pronounced by eastern buyers to be the equal of any seen in that market in recent years.

GROVE CITY CREAMERY.

The creamery at Grove City, Pa., operated under the management of the Dairy Division, is an excellent example of the influence of a well-managed creamery upon a locality. Begun in 1915 with only 54 patrons the first month, the creamery at the close of the last year had 579 patrons, from whom 378,000 pounds of butter fat were purchased during the year at a price well above that generally prevailing. In

addition to the manufacture of 425,084 pounds of butter, 139,585 pounds of cottage cheese was made, 1,504,025 pounds of milk was condensed, and 5,441 pounds of casein manufactured.

CONSERVING AND UTILIZING DAIRY BY-PRODUCTS.

Present conditions demand the conservation of all agricultural products, especially those that can be used as human food. A campaign is therefore being conducted to eliminate waste of dairy products and for converting dairy by-products into nutritious and palatable food. Special emphasis has been placed upon the home production of cottage cheese from skim milk and its commercial production from buttermilk and skim milk. Several publications on the preparation and utilization of cottage cheese were issued and distributed.

Methods of making cottage cheese have been demonstrated in creameries and milk plants and before county and State agricultural agents, home-economic specialists, women's clubs, and various other organizations. This work has resulted in the saving of much that normally would have been wasted and has caused large quantities of dairy by-products to be converted into human food. For example, one creamery in New York State is condensing daily 25,000 pounds of skim milk, much of which formerly was run into the sewer, and several creameries now make their entire supply of skim milk into cottage cheese.

INSPECTION OF BUTTER FOR THE NAVY.

Supervision was given in 1916 to the manufacture of 700,000 pounds of high-grade butter for the Navy, which upon inspection nine months later had deteriorated only one point. Tinned butter packed for the Navy nearly three years before was in good condition when examined last winter. This well emphasizes what can be accomplished with high-quality cream and careful methods of manufacture.

INSPECTION OF RENOVATED BUTTER FACTORIES.

The 23 factories that hold licenses to manufacture renovated butter were inspected regularly during the year. From them a total of 27,542,015 pounds of the renovated product was turned out, of which 635,038 pounds was exported. On the whole, packing stock was better handled by middlemen, which resulted in a slight improvement in the quality.

MARKET MILK INVESTIGATIONS.

DAIRY SANITATION.

In endeavoring to improve the quality of milk delivered to cities and towns, assistance has been rendered to local health authorities in determining conditions and by suggesting remedies. Particular attention is given to methods of inspection and at all times the work is made educational. Only such changes are recommended for dairies as are practicable and can be carried out with the minimum of expense. Such work has improved the conditions under which milk is produced for many cities, as is well illustrated by a city in Minnesota.

When the work began a score of 69 represented the average sanitary conditions on the farms where milk was produced. A year later the same farms scored 76, a marked improvement in so short a time.

During the year very careful surveys were made of a number of cities in different parts of the country. A survey at St. Louis, in cooperation with the Bureau of Chemistry, primarily to determine the sources of contamination of the milk supply, strikingly illustrated the effect of a few simple factors. Efficient sterilization of utensils and proper cooling and refrigeration of the milk were found to be of great importance in lowering the bacterial count and, consequently, in improving the quality of milk.

In a study of the condition of the milk supply of New England, also carried on in cooperation with the Bureau of Chemistry, visits were made to many farms that supplied milk to the principal cities and towns. Special attention was given to those farms whose milk, when examined at the shipping stations, showed more than a million bacteria per cubic centimeter. Improved methods were suggested, which resulted in lowering the average bacterial count from 27,000,000 to 750,000. Probably the most important single factor in that work was cooling the milk and keeping it at a sufficiently low temperature. In fact, the lowering of the temperature of the milk 8 degrees to an average of 54° F. may be considered as the main cause of the improvement.

MILK CONTESTS.

Milk and cream contests have proved to be a very potent influence for the betterment of municipal milk supplies. In the contests samples of milk are submitted by dairies and dealers, and are scored upon the basis of composition, flavor, odor, bacterial content, and sediment. The defects are explained to the competitors at a meeting and the remedies pointed out.

In some places, particularly along the Pacific coast, the contests are conducted on a slightly different plan. At irregular intervals, without notice to the contestants, samples for scoring are selected from the milk wagons, so that the contest is in the nature of a surprise. Under this plan the milk from the dairies is constantly graded.

While the results accomplished are often difficult to measure, a study of data from milk contests has shown that in every case the samples entered by a contestant in later contests scored higher than those entered by him at the first contest.

FARM STERILIZER CAMPAIGN.

A nation-wide campaign to demonstrate the value of the sterilization of farm dairy utensils was begun in the early part of 1917. Twenty outfits of the simple steam sterilizer designed by the division were started over as many routes and visited 184 cities in 43 States. In each place a two-weeks demonstration was held by the local health officer to show producers how easily and cheaply they could improve the quality of their milk by the proper sterilization of milk utensils.

Thirty per cent of 116 demonstrators who have reported state that already sterilizers are being used by producers in their communities. Farmers' Bulletin 748 describing the sterilizer was issued and widely distributed.

MILK-PLANT MANAGEMENT.

More efficient operation and the elimination of waste are the objects of the efforts in milk-plant management. Simple methods of checking milk bottles, often an important item of loss, and a simplified system of accounting, have been worked out and put into successful operation in a number of milk plants. In a large number of milk plants in representative cities careful studies were made also of the cost of delivering milk both by horse-drawn and motor-driven vehicles. Much milk is lost in the process of handling in some milk plants, and this loss, or shrinkage as it is called, often amounts to a considerable figure. For example, the economies affected in that particular in one plant caused a yearly saving of \$2,836. Assistance in this respect was given to various plants during the course of the investigation mentioned. Plans and specifications for construction and equipment were drawn up and furnished to milk plants that requested such assistance, and special efforts were made to help cooperative plants.

COST OF MILK PRODUCTION.

The cost of producing milk, a subject of vital concern to thousands of dairy farmers, is being studied intensively in three representative localities in North Carolina, Indiana, and Vermont. By means of monthly visits and the keeping of records on a definite number of farms, a specialist gathers accurate information. The dairymen in the Indiana district by feeding an abundance of legume hay were able to reduce their grain bills materially without lessening the milk flow.

OTHER INVESTIGATIONS.

Ordinary methods of cooling milk and cream on the farm are not very effective. To determine the relative efficiency of cooling tanks made of wood, concrete, galvanized iron, and wood insulated with cork board, tests are being carried on under all the conditions that may be found upon the average farm.

Various common feeds, such as turnips and other root crops, silage, and soiling crops, are being studied with reference to their effect upon flavor and odor. This study includes the transmission of odor or flavor not only when the cows eat the feed but when the milk is exposed to it.

Experiments are being carried on with several new types of farm sterilizers which have the additional feature of heating water for washing utensils.

A study of the municipal milk and cream ordinances of many cities revealed considerable diversity. There is a like diversity in the salaries, training, length of service, and method of appointment of dairy inspectors in States and cities.

To prevent waste, efforts have been made to induce city health authorities to denature, rather than destroy milk condemned as unfit for human consumption. Several cities have already adopted the practice, and the denatured milk is now fed to live stock.

DAIRY EXPERIMENT FARM.**INBREEDING.**

Experimental work has been continued at the Dairy Division experiment farm at Beltsville, Md. Inbreeding, commonly believed to cause weakened or deformed offspring, is recognized as being also a very potent factor in the improvement of live stock. An investigation was begun in 1912 to determine the practicability of obtaining rapid improvement in common dairy stock by breeding the daughters of vigorous, well-bred, registered bulls to their sires. So far only one bull has been used, and 16 of his 34 daughters have dropped calves. Four calves were deformed, having an upward curvature of the spine, and were dead at birth or died shortly thereafter. The work has not progressed far enough for the results to be conclusive, and other bulls are being tried in the same manner.

FEEDING EXPERIMENTS WITH CALVES.

In view of the emphasis that has been placed upon vitamins as necessary for proper growth and development in young animals, preliminary experiments in feeding calves have been started to test the value and effect of these substances.

Phosphorus and calcium, already demonstrated as having an important effect upon the milk production of cows, are being fed in various combinations to determine their effect upon the growth and development of heifer calves.

In order to free as much whole milk and skim milk as possible for human food, studies have been carried on to determine the minimum quantities necessary for successful calf raising.

FEEDING EXPERIMENTS WITH COWS.

Fish meal, a by-product of the fish canneries, when used in a ration for milk production proved to be worth from 20 to 25 per cent more than cottonseed meal and had no ill effect upon the flavor of milk. Potato silage was found to be as palatable as corn silage and of equal feeding value, pound for pound; peanut meal from unhulled nuts was inferior to cottonseed meal; and 128 pounds of potato meal equaled 100 pounds of corn meal as a feed for dairy cows.

HOUSING DAIRY CATTLE.

A warm barn, commonly deemed essential for large milk production during the winter months, proved to be less satisfactory than the open shed. In experiments extending over three years, the cows housed in the open shed consumed a little more feed, required more bedding, and the trouble of stalling them twice daily slightly increased the labor cost; but, because more milk was produced and on account of the lower cost of housing, the open shed proved somewhat more economical. In the latitude of Beltsville at least the open shed offers advantages that may well be considered by the dairy farmer.

MEAT INSPECTION DIVISION.

R. P. STEDDOM, *Chief.*

The figures for the Federal meat inspection exceeded the previous high mark of the fiscal year 1916 in the total number of animals slaughtered, in the quantity of meats processed, and in the quantity of meats and products certified for export.

INSPECTION OF DOMESTIC MEATS.

Inspection was conducted at 883 establishments in 253 cities and towns as compared with 875 establishments in 244 cities and towns during the preceding year.

Inspection was begun at 84 and withdrawn from 82 establishments during the year as compared with 80 and 76, respectively, during 1916. Inspection was withdrawn from 71 establishments on account of the discontinuance of slaughtering or of interstate business, from 4 for failure to comply with department requirements, from 1 by request, and 6 establishments were transferred to market inspection.

The ante-mortem inspections, as given in the following table, show an increase in the number of cattle and calves inspected, and a decrease for each of the other species, the increase in the total inspections being 2.4 per cent over the fiscal year 1916.

Ante-mortem inspection of animals.

Class of animal.	Passed.	Suspected. ¹	Condemned. ²	Total inspected.
Cattle.....	9,223,477	92,657	67	9,316,201
Calves.....	2,669,788	5,361	56	2,675,205
Sheep.....	11,341,906	6,461	9	11,348,376
Goats.....	174,717	143	2	174,862
Swine.....	40,179,990	115,487	6,202	40,301,679
Total.....	63,589,878	220,109	6,336	63,816,323

¹ This term is used to designate animals found or suspected of being unfit for food on ante-mortem inspection, most of which are afterward slaughtered under special supervision, the final disposal being determined on post-mortem inspection.

² For additional condemnations see succeeding tables.

The post-mortem inspections show an increase of 2.6 per cent over the preceding year and an increase of 15 per cent over the average for the preceding decade during which the new meat-inspection law has been operative. While there was a decrease in the number of sheep, goats, and swine slaughtered, the increase in cattle amounted to nearly 2,000,000 and in calves to over half a million.

Post-mortem inspection of animals.

Class of animals.	Passed.	Condemned.	Total inspected.
Cattle.....	9,220,783	78,706	9,299,489
Calves.....	2,669,633	10,112	2,679,745
Sheep.....	11,328,669	16,749	11,345,418
Goats.....	173,300	1,349	174,649
Swine.....	40,052,367	158,480	40,210,847
Total.....	63,442,762	265,396	63,708,148

The next two tables show the diseases and conditions for which condemnations were made.

Diseases and conditions for which condemnations were made on ante-mortem inspection.

Cause of condemnation.	Cattle.	Calves.	Sheep.	Goats.	Swine.
Arthritis.....		1			3
Dysentery.....		1			1
Emaciation.....	4		1		24
Hog cholera.....					6,069
Injuries.....	4	2		2	13
Moribund.....	9				
Parturient apoplexy.....	1				
Pneumonia, etc.....	32	45	7		46
Pregnancy and recent parturition.....	3				
Salt poisoning.....		6			1
Septicemia.....	5				34
Tetanus.....	3		1		2
Texas fever.....	1	1			
Tuberculosis.....	3				
Tumors and abscesses.....	2				9
Total.....	67	56	9	2	6,202

Diseases and conditions for which condemnations were made on post-mortem inspection.

Cause of condemnation.	Cattle.		Calves.		Sheep.		Goats.		Swine.	
	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.	Car-casses.	Parts.
Actinomycosis.....	1,204	173,282	10	1,901		3				34
Addison's disease.....	1									
Adenitis.....	1								2	
Arthritis.....	48	17		12		29			4,343	54
Asphyxiation.....	21		3		37				1,255	
Atrophy.....		2				1				
Autointoxication.....	2				3					
Blackleg.....	29		13							
Bone diseases.....	9	6							51	6
Caseous lymphadenitis.....					2,672	91	77	40		
Cellulitis.....									10	618
Congestion.....	14				10				38	
Contamination.....	6	1,779		63	2	156			330	8,821
Cysticercus.....	446	1,284	31	3	289	2	2		479	
Dropsical diseases.....	23	2			19		3		91	
Emaciation.....	14,254		2,855		5,531		1,094		1,081	
Exhaustion.....					7					
Frozen.....						2			61	2
Gangrene.....	82		26		8		1		111	
Hernia.....	6		1		6				25	
Hog cholera.....									33,450	
Hydronephrosis.....	1				1				16	
Icterus.....	45				1,256		12		2,697	
Immaturity.....			1,851		3		7		48	
Injuries, bruises, etc.....	3,829	574	478	82	572	96	7	2	1,332	13,380
Leukemia.....	451		25		14				110	
Melanosis.....	27	11	19	2	10		13		114	
Moribund.....	23		4		25				43	
Necrobacillosis.....	22		2						2	
Necrosis.....	2	839		1	2	3			4	1
Parasitic diseases.....	9	9		1	28	2	4		487	
Phlebitis.....			140							
Pneumonia, peritonitis, metritis, enteritis, pleurisy, etc.....	7,920	95	2,868		5,479	2	70		18,920	
Pregnancy and recent parturition.....	61				13		18		30	
Septicemia, pyemia, and uremia.....	2,443		390		641		20		13,734	
Sexual odor.....							13		1,231	
Skin diseases.....	1								30	
Tetanus.....	1									
Texas fever.....	811		664							
Tuberculosis.....	46,351	68,872	656	616	3				79,807	495,565
Tumors and abscesses.....	563	2,865	25	246	118	26	8		1,548	9,907
Total.....	78,706	249,637	10,112	2,927	16,749	413	1,349	42	158,480	528,288

The following table shows the total condemnations on ante-mortem and post-mortem inspection combined:

Summary of condemnations.

Class of animals.	Animals or carcasses.	Parts.
Cattle.....	78, 773	249, 637
Calves.....	10, 168	2, 927
Sheep.....	16, 758	413
Goats.....	1, 351	42
Swine.....	164, 682	528, 288
Total.....	271, 732	781, 307

In addition to the foregoing, the carcasses of 65,677 animals found dead or in a dying condition were tanked, as follows: Cattle, 4,611; calves, 2,976; sheep, 6,295; goats, 238; swine, 51,557; total, 65,677.

The inspection and supervision of meats and products prepared and processed is shown in the following table, which is a record only of supervisory work performed and not a statement of the aggregate quantity of products prepared. The same product is sometimes duplicated by being reported in different stages of preparation under more than one heading.

Meat and meat food products prepared and processed under inspection.

Kind of product.	Pounds.	Kind of product.	Pounds.
Placed in cure—Beef.....	285, 141, 107	Neutral lard.....	62, 438, 087
Pork.....	2, 918, 210, 827	Lard oil.....	4, 597, 435
All other.....	2, 721, 941	Lard stearin.....	3, 194, 360
Sausage chopped.....	635, 860, 304	Lard compound.....	8, 708, 806
Canned product—Beef.....	242, 445, 611	Compound-lard substitute.....	457, 489, 227
Pork.....	35, 103, 308	Oleo stock and edible tallow.....	66, 603, 468
All other.....	5, 769, 793	Oleo oil.....	139, 984, 538
Sterilized product—Beef.....	3, 954, 706	Oleo stearin.....	72, 609, 451
Pork.....	7, 270, 577	Oleomargarin.....	225, 074, 278
All other.....	4, 523	Miscellaneous products.....	1, 428, 160, 088
Meat extract.....	1, 414, 235	Total.....	7, 663, 633, 957
Steam and kettle rendered lard.....	1, 039, 945, 751		
Leaf lard.....	16, 931, 636		

The amount of meat and meat food products condemned on reinspection on account of having become sour, tainted, putrid, unclean, rancid, or otherwise unwholesome, was as follows: Beef, 8,799,472 pounds; pork, 10,853,071 pounds; mutton, 124,840 pounds; veal, 79,164 pounds; goat meat, 723 pounds; total, 19,857,270 pounds. The excess condemnation of nearly two million pounds during 1917 as compared with 1916 is due to a fire at an establishment in one of the western cities.

Market inspection was discontinued during the fiscal year at two cities, leaving 42 cities at whose public markets this inspection is maintained in order that interstate deliveries of meats and products may be made therefrom.

MEAT AND PRODUCTS CERTIFIED FOR EXPORT.

The following products were certified for export under certificates and stamps: Beef and beef products, 475,572,431 pounds; mutton and mutton products, 3,944,658 pounds; pork and pork products, 1,473,576,220 pounds; a total of 1,953,093,309 pounds. In addition there were issued 430 certificates covering the export of 6,370,434 pounds of inedible animal products.

EXEMPTION FROM INSPECTION.

The provisions of the meat-inspection law requiring inspection usually do not apply to animals slaughtered by a farmer on a farm nor to retail butchers and dealers supplying their customers. It is required, however, that the retail butchers and dealers, in order to ship meat and meat food products in interstate or foreign commerce, shall first obtain certificates of exemption. The number of exemption certificates outstanding at the close of the fiscal year was 2,456, an increase of 61 over the preceding year. During the year 138 certificates were canceled, 112 on account of the dealers retiring from business or ceasing to make shipments, 25 for violations of the regulations, and one dealer was granted inspection.

During the fiscal year 67,779 shipments were made by retail dealers and butchers holding certificates of exemption, as compared with 79,629 shipments during the fiscal year 1916. The shipments of the year covered products as shown in the following table:

Shipments by retail dealers and butchers under certificates of exemption from inspection.

Product.	Number.	Pounds.	Product.	Number.	Pounds.
Beef, carcasses (2,804 quarters).....	701	286,611	Pork, fresh.....		288,796
Calves, carcasses.....	36,034	3,116,911	Cured meats.....		472,749
Sheep, carcasses.....	1,676	71,128	Lard.....		38,092
Swine, carcasses.....	893	97,647	Sausage.....		95,414
Beef, fresh.....		1,615,599	Miscellaneous (scrapple, tripe, headcheese, etc.).....		51,198
Veal, fresh.....		237,411			
Mutton, fresh.....		327,043	Total.....	39,304	6,698,597

During the fiscal year 87,486 interstate shipments were made of meats and meat food products from animals slaughtered by farmers on the farm, as compared with 89,579 shipments during the fiscal year 1916. The following table shows the products covered by these shipments:

Shipments of farm-slaughter products under exemption from inspection.

Product.	Number.	Pounds.	Product.	Number.	Pounds.
Beef, carcasses (4,738 quarters).....	1,184	420,646	Pork, fresh.....		214,656
Calves, carcasses.....	109,701	9,850,120	Cured meats.....		934,346
Sheep, carcasses.....	4,645	172,060	Lard.....		242,255
Swine, carcasses.....	20,490	2,056,283	Sausage.....		116,127
Beef, fresh.....		86,826	Miscellaneous (scrapple, tripe, headcheese, etc.).....		28,198
Veal, fresh.....		72,068			
Mutton, fresh.....		3,257	Total.....	136,020	14,146,842

INSPECTION OF IMPORTED MEATS.

The following table shows the inspection of imported meats and meat food products for the fiscal year, and represents a decline of 73.6 per cent from the inspections of the fiscal year 1916:

Imported meat and meat food products inspected.

Country of origin.	Fresh and refrigerated meats.		Cured and canned meats.	Other products.	Total weight.
	Beef.	Other classes.			
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
Argentina.....	2,614,301	4,686,798	2,610,072	677,793	10,588,964
Australia.....			10	87,493	37,573
Brazil.....	3,207,217		55,224		3,262,441
Canada.....	9,635,697	2,981,986	998,537	285,923	13,902,443
Uruguay.....	46,230	17,051	1,020,572		1,083,853
Other countries.....	59,715	229	162,581	41,267	263,792
Total.....	15,563,160	7,686,064	4,847,296	1,042,476	29,138,996

The following statement shows the condemnations of imported meats and the amount refused entry on account of lack of foreign certificates or other failure to comply with the regulations.

Imported meat products condemned or refused entry.

Product.	Condemned.	Refused entry.
	<i>Pounds.</i>	<i>Pounds.</i>
Beef.....	329,550	713
Veal.....	16,524	
Mutton.....	393	140
Pork.....	25,693	13,758
Total.....	382,160	14,611

INSPECTIONS FOR OTHER BRANCHES OF THE GOVERNMENT.

By request of other branches of the Government, reinspections of meats and meat food products to determine whether they were wholesome and conformed to the specifications were made during the fiscal year as follows:

Inspection of meat for other branches of the Government.

Department or branch.	Inspected.	Rejected.
	<i>Pounds.</i>	<i>Pounds.</i>
Navy Department.....	24,017,321	682,021
War Department.....	26,190,222	162,083
Interior Department (Office of Indian Affairs).....	563,165	56,796
Department of Labor (Immigration Service).....	63,398	
Alaskan Engineering Commission.....	262,790	72,953
Total.....	51,066,896	973,853

MEAT-INSPECTION LABORATORIES.

In the meat-inspection laboratories maintained in Washington and in six other cities samples of each meat food product prepared at official establishments have been examined and analyzed to determine if they were properly labeled or contained any deleterious substance. Samples of the various materials used in the curing and preparation of meat and products, such as water, spices, salt, etc., and of the various substances used in and around the establishments, such as inks, disinfectants, insect and rodent exterminators, were examined, and permission for use was based upon the results of such examinations.

Samples to the number of 59,916 were examined in the laboratories during the year, 59,263 being domestic and 653 imported products. These figures show an increase of nearly 4,500 over the number for the previous year. One thousand three hundred and thirty-six samples were found not to be in accordance with the regulations, 44 of which were from imported products. Water supplies from 832 sources were examined, 109 of which were condemned for use in the preparation of meat products.

Great improvement has been noted in the quality of the nitrate of soda (Chile saltpeter) being furnished to the packing houses. This was largely due to the number of samples of this salt rejected on account of the presence of borax, which resulted in the refiners improving their methods of purifying, so that now borax has been practically eliminated. Special investigations have been conducted during the year as to the sources and handling of the different brands of common salt used in packing houses, of the storage of spices at the inspected establishments, and of the sources of the water used in the preparation of meat food products, and decided improvements have already been brought about as a result of these investigations.

The Washington meat-inspection laboratory has devised new chemical tests for rancidity in fats, for the detection of added water in sausage, and for the separation and identification of the permitted coal-tar colors. These new methods are of great assistance in the analysis of meat food products.

Pasteurization of all dairy products used in the preparation of oleomargarin is now required in establishments under the Federal meat inspection. Creameries supplying these products to the inspected establishments have been visited to insure pasteurization.

QUARANTINE DIVISION.

R. W. HICKMAN, *Chief.*

INSPECTION AND QUARANTINE OF IMPORTED ANIMALS.

While there have been no outbreaks of foot-and-mouth disease in Great Britain during the past year such as occurred in the preceding year, the interference with shipping owing to the war has resulted in again keeping importations of live stock below the normal average.

The following tables show the importations of the various classes of live stock through the different ports of entry:

Imported animals inspected and quarantined.

Port of entry.	Cattle.	Sheep.	Swine.	Other animals.
New York.....	1,518	30	4	90
Boston.....	277	376		
San Francisco.....		456		502
Canadian-border ports.....	2,631	337	93	238
Total.....	4,426	1,199	97	830

Imported animals inspected but not quarantined.

Port of entry.	Cattle.	Sheep.	Swine.	Goats.	Horses.	Other animals.
New York.....					870	
Boston.....	277	376			8	3
Baltimore.....					3	
Philadelphia.....					1	12
San Francisco.....		405			5	45
New Orleans.....					43	
Key West.....					1	
Tampa.....				2	4	
Mexican-border ports.....	185,366	98,604	1,209	20,366	12,166	
Canadian-border ports.....	179,345	57,289	4,680	23	13,058	142
Total.....	364,988	156,674	5,889	20,391	26,159	202

An inspector of the bureau stationed in Great Britain applied the tuberculin test to cattle for shipment to the United States, as shown in the following table. This service is performed upon the request of importers. Cattle not accompanied by satisfactory certificates of tuberculin test signed or approved by the bureau's inspector must be tested in quarantine after arrival in this country.

Results of tuberculin tests of cattle for importation into the United States.

Breed.	Tested in Great Britain.		Tested in quarantine.	
	Passed.	Failed.	Passed.	Failed.
Ayrshire.....	96	2	8	1
Aberdeen-Angus.....	2			
Guernsey.....	744	2	369	19
Hereford.....	12			
Jersey.....	284	1	117	
Shorthorn.....	305	50	75	8
Total.....	1,443	55	569	28

IMPORTATIONS OF HIDES, WOOL, HAY, STRAW, ETC.

The prevalence of anthrax and foot-and-mouth disease in hide-exporting countries and the impossibility of obtaining reliable statements or satisfactory certificates regarding these and other diseases in such countries made desirable certain changes in the requirements

governing the importation of hides, skins, and other products. Accordingly new regulations, known as Treasury Department and Department of Agriculture Joint Order No. 1, were issued October 21, 1916, effective January 1, 1917, entitled "Regulations governing the certification and disinfection of hides, fleshings, hide cuttings, parings, and glue stock, sheepskins and goatskins and parts thereof, hair, wool, and other animal by-products, hay, straw, forage, or similar material offered for entry into the United States." Special arrangements were made for the careful handling of imported hides and other animal by-products at the various ports of entry and their disinfection at destination under official supervision.

Shipments from Canada are excluded from the requirements of these regulations, because of the lack of danger of the introduction of disease through the importation of such articles from that country, the regulations providing that such articles may be imported into the United States from Canada without being disinfected or certified so long as the favorable conditions continue.

INSPECTION OF VESSELS AND EXPORT ANIMALS.

Heavy shipments of horses and mules to Europe have continued. Seven hundred and five inspections of vessels carrying live stock were made before clearance, and 168 certificates of inspection were issued for American cattle, sheep, swine, and horses for shipment to foreign countries.

The mallein test for the detection of glanders was applied to 7,969 horses and 1,676 mules for shipment to Canada. Five of these animals reacted and were rejected. Also, there were tested with tuberculin 1,229 cattle for shipment to Canada, with 33 reactors. Inspections for Canadian shipment were made of 505 sheep, 74 swine, and 77 goats.

For shipment to other countries 1,043 cattle were tested with tuberculin and 18 reacted; the mallein test was applied to 10 horses and 147 mules, and 15 swine and 4 goats were inspected.

The following table gives statistics of inspections of live stock for export. Included in the figures are 215,096 horses and 122,381 mules exported to Europe for Army purposes, which were inspected chiefly by officials of the countries to which they were consigned.

Inspections of American and Canadian animals for export.

Kind of animals.	American.	Canadian.
Cattle.....	2,028	42
Sheep.....	842	.....
Swine.....	155	.....
Goats.....	9	.....
Horses.....	207,918	7,512
Mules.....	122,275	1,461
Total.....	333,227	9,015

FIELD INSPECTION DIVISION.

A. W. MILLER, *Chief.*

INSPECTION FOR FOOT-AND-MOUTH DISEASE.

Following the eradication of foot-and-mouth disease, and as a precaution against its reappearance, experienced veterinarians stationed at public stockyards were specially detailed to make careful inspections for this disease in all receipts of cattle, sheep, and swine. All suspected outbreaks reported to the bureau were investigated promptly, but no case of the disease was found during the year.

ERADICATION OF SCABIES.

In the work for the eradication of sheep scabies in cooperation with State officials 18,645,071 inspections of sheep were made in the field by bureau employees, and 5,539,919 sheep were dipped. Outbreaks of the disease which occurred during the fiscal year in Montana and Nevada, traceable to shipments into these States, in which the disease had not existed for several years, are being rapidly brought under control. Work for the eradication of sheep scabies was begun in Texas during the fiscal year by the bureau in cooperation with officials of that State. During the fiscal year 9,702 square miles in California and 20,061 square miles in Colorado were released from quarantine as a result of eradication accomplished.

In the eradication of cattle scabies in cooperation with State officials bureau employees in the field made 1,924,970 inspections of cattle, and 343,517 cattle were dipped. A number of outbreaks of cattle scabies occurred during the year in several States in localities in which the disease had not been prevalent for a number of years. Prompt action was taken to prevent the spread of the disease and to eradicate it from the affected herds.

Horses and mules to the number of 17,567 were inspected for scabies, and the dipping of 60 of these animals was supervised by bureau employees.

ERADICATION OF DOURINE.

Although some new areas of infection were discovered during the fiscal year, good results have been accomplished in the work of eradicating dourine. This work has been practically completed in Iowa and Nebraska and is nearing completion in North Dakota and Wyoming. Considerable areas of infection still remain, however, in Arizona, Montana, New Mexico, and South Dakota. Officials of the States concerned and most of the horsemen in the infected areas have cooperated with the bureau in a satisfactory manner. As funds have been available, the bureau is continuing the practice of paying one-half of the appraised valuation of infected horses destroyed, such share not to exceed \$100 in any case. The number of animals tested and the results of tests are reported under the heading of the Pathological Division. The percentage of reactions is 2.47, as compared with 3.1 for the preceding year. A very large proportion of the infection was found among horses ranging on Indian reservations.

INSPECTIONS OF ANIMALS FOR INDIAN AGENCIES.

In cooperation with the Office of Indian Affairs of the Department of the Interior, 257 horses and mules were inspected, of which 219 were passed for allotment to the several Indian agencies; likewise 30 cattle were inspected and passed.

TICK ERADICATION DIVISION.

R. A. RAMSAY, *Chief*.

ERADICATION OF SOUTHERN CATTLE TICKS.

As the result of the work done in cooperation with the authorities of the various Southern States for the extermination of the cattle tick, areas aggregating 40,111 square miles were released from quarantine during the fiscal year. The work is also far advanced in a large additional territory. The total area released since the beginning of this work in 1906 amounts to 312,012 square miles, which is 43 per cent of the originally infected area. This amounts to a territory greater than the combined areas of Florida, Georgia, Alabama, Mississippi, Tennessee, and North Carolina. The areas released during the year and the total to date are shown in the following table:

Areas released from quarantine as a result of eradicating cattle ticks.

State.	Square miles released during fiscal year 1917.	Total square miles released from beginning of work to June 30, 1917.	State.	Square miles released during fiscal year 1917.	Total square miles released from beginning of work to June 30, 1917.
Alabama.....	12, 195	21, 502	North Carolina.....	1, 598	26, 612
Arkansas.....	3, 364	18, 268	Oklahoma.....	2, 307	22, 273
California.....	720	79, 924	South Carolina.....	3, 809	21, 876
Florida.....		3, 800	Tennessee.....		16, 987
Georgia.....	4, 815	16, 563	Texas.....	5, 424	37, 132
Kentucky.....		841	Virginia.....		12, 142
Louisiana.....		1, 702			
Mississippi.....	5, 879	31, 004	Total.....	40, 111	312, 012
Missouri.....		1, 386			

During the year 24,390,721 inspections or dippings were made of cattle for the eradication of ticks, as against 16,281,185 in the preceding year. There were in operation 23,491 cattle-dipping vats, where cattle were dipped under Federal or State supervision to rid them of ticks.

In addition to a large number of inspections made and dippings supervised, a great deal of advance work pertaining to the construction of dipping vats and preparing counties and localities for taking up tick eradication in the near future was conducted by bureau employees in an effort to get proper organization in such localities. Cattle owners in the tick-infested region as a result of this preliminary work are realizing more and more the importance of tick eradication and the benefits to be derived from it both locally and

nationally, and it seems likely that during the next fiscal year the systematic dipping of cattle to free them from ticks will be taken up in a greatly increased area. Very effectual cooperation has come also from transportation companies, commercial clubs, bankers, and other business men who are far-sighted enough to realize that the eradication of the cattle tick and the subsequent development of the livestock industry mean an increase of business for all concerned.

SHIPMENTS FROM QUARANTINED AREAS.

The number of inspections of cattle of the quarantined area shipped to market centers for immediate slaughter was 2,040,609, which is a considerable increase over the previous year, and was brought about by local conditions, such as drought, which required the immediate marketing of many cattle. "Dipped ticky cattle" to the number of 6,259 were shipped to points where inspection is provided and dipping facilities maintained for further treatment for movement as noninfectious. The number of cattle inspected or dipped and certified at points other than public stockyards for interstate movement as noninfectious as provided for in the regulations was 151,571. To cover the shipments of these cattle, 1,672 certificates were issued.

TUBERCULOSIS ERADICATION DIVISION.

J. A. KIERNAN, *Chief.*

The Tuberculosis Eradication Division was formed May 1, 1917, with a view to increasing greatly the scope of activities looking toward the ultimate eradication of tuberculosis from the live stock of the country. This report includes certain work carried on prior to that date in the Quarantine and Field Inspection Divisions and continued in the new division.

COOPERATIVE TUBERCULOSIS INVESTIGATIONS.

The cooperative work for the suppression of cattle tuberculosis has been continued with the owners of herds, with the dairy and food division of Virginia, with the Commissioners of the District of Columbia, and with the Office of Indian Affairs of the Department of the Interior.

The establishment of pure-bred herds of cattle free from tuberculosis as determined by tuberculin tests applied under bureau supervision is being materially increased by the tuberculin testing of these herds in widely separated sections of the United States. Active cooperation in this work has been given by herd owners and by organizations promoting the cattle industry.

In the work with the Office of Indian Affairs the tuberculin test was applied to 413 cattle upon 14 reservations, and 6.5 per cent reacted to the test. These inspections disclosed improvement in the quality of the cattle and in the sanitary conditions under which milk is produced.

In the District of Columbia, where the compulsory tuberculin test has been a requirement since November, 1909, the work has been continued with cooperation upon the part of private cattle owners and of

the cattle dealers. A complete testing of all cattle in the District during the past year resulted in only 0.84 per cent of reactions, as compared with 18.87 per cent in the first year of the work. Tuberculin tests applied to cattle entering the District from the surrounding States disclosed 6.4 per cent of tuberculous animals which, if they had been permitted to mingle with the healthy cattle of the District, would have caused within a short time a return to a higher percentage of tuberculosis. Cattle are kept in about 350 locations within the District.

Continuation of cooperation with Virginia farmers and the Virginia dairy and food division has shown an even greater reduction in the percentage of tuberculosis among the cattle which are submitted to the tuberculin test for the first time, the percentage for the past year being 6.3 as compared with 18.27 in 1910.

In the progress of this work in the past year, cooperation was extended to about 1,100 cattle owners and tests were applied to 20,101 cattle, of which 3.21 per cent reacted. The following table summarizes the work:

Results of cooperative tuberculin testing of cattle.

	Total.	Passed.	Reacted.	Percentage of reactors.
Indian schools.....	413	386	27	6.5
Maryland:				
Original tests.....	325	285	40	12.33
Annual retests.....	1,387	1,361	36	2.58
Total.....	1,712	1,636	76	4.43
Virginia:				
Original tests.....	3,712	3,477	235	6.33
Annual retests.....	8,329	8,212	117	1.4
Total.....	12,041	11,689	352	2.92
District of Columbia:				
Annual retests.....	1,060	1,051	9	.84
Interstate entries.....	389	365	24	6.44
Total.....	1,449	1,416	33	2.27
Pure-bred herds:				
Original tests.....	2,452	2,351	101	4.11
Annual retests.....	2,034	1,978	56	2.75
Total.....	4,486	4,329	157	3.5

Plans have been made for the work against animal tuberculosis to be carried on under three projects, as follows: (1) Tuberculosis eradication among pure-bred herds of cattle; (2) tuberculosis eradication among swine; (3) tuberculosis eradication in circumscribed areas. Arrangements have been made with officials of a number of additional States for cooperative work.

LIVE-STOCK SANITARY WORK IN INTERSTATE COMMERCE.

In the course of the inspection and quarantine service to prevent the spread of animal diseases through interstate commerce, 2,074,498 inspections were made at market centers of cattle from the area quaran-

tined for splenetic or tick fever. The number of cattle of the quarantined area dipped at public stockyards during the fiscal year was 106,695. Of this number, 50,341 were dipped a second time, in order that they might be disposed of for other purposes than immediate slaughter. During the year 1,811 certificates were issued for shipment of free cattle and those dipped or otherwise treated as provided for in the regulations. There were also dipped, on account of splenetic-fever ticks, 748 horses and mules, certificates for the interstate movement of which were issued.

Cattle to the number of 18,069,218 were inspected at market centers for scabies and other contagious diseases, and 20,963 were dipped under bureau supervision in order that they might continue in interstate transit. Likewise 19,368,277 sheep were inspected at stockyard centers for scabies and other contagious diseases, and 973,272 were dipped under bureau supervision in order that they might be disposed of for purposes other than immediate slaughter.

Swine to the number of 94,720 were inspected, and under the bureau's supervision were given the immunization treatment against hog cholera, for interstate shipment from public stockyards.

There were inspected by bureau veterinarians, in compliance with the laws of the States to which the animals were destined, and upon request of transportation companies or shippers, 134,607 cattle moving interstate for purposes other than immediate slaughter, of which number 45,713 were tested with tuberculin. Of the number tested, 1,108 were found to be diseased with tuberculosis, and 321 showed temperatures which required them to be held as suspects for further examination.

There were also inspected by bureau veterinarians, in compliance with the laws of the States to which the animals were destined, and upon request of transportation companies or shippers, 30,555 horses and mules, 9,574 of which were tested with mallein, 3 showing typical reactions to the test and 2 being held for further examination.

There were reported by bureau stations as arriving at points where inspection is maintained 31,831 cars carrying animals affected with a contagious, infectious, or communicable disease. During the year 61,798 cars were cleaned and disinfected under bureau supervision on account of bureau regulations or on request of Canadian Government officials, State officials, or transportation companies.

VIOLATIONS OF LIVE STOCK TRANSPORTATION AND QUARANTINE LAWS.

The bureau has continued to report to the Solicitor of the department, for presentation to the Attorney General for prosecution, cases of apparent violations of live-stock transportation and quarantine laws. Many of these cases have required special investigation on the part of bureau employees, such as interviewing witnesses and examining railroad and other records for the completion of evidence. Six bureau employees were regularly assigned to this work, though the greater part of the work of collecting evidence and preparing and submitting reports is done by bureau employees at stockyard centers, in connection with their other duties.

PATHOLOGICAL DIVISION.

JOHN R. MOHLER, *Chief.*

Dr. A. Eichhorn was Chief of the Pathological Division until his resignation, which took effect December 31, 1916, after which Dr. John R. Mohler, assistant chief of the bureau, was placed in charge of this division, in addition to his other duties.

ABORTION DISEASE.

Efforts to reduce the seemingly ever-increasing losses due to the dissemination of infectious abortion of cattle have been continued. The difficulty with which this disease is eradicated, even in herds that are maintained under the most sanitary conditions, has served to demonstrate that its avoidance is a relatively simple matter as compared with its control when once the infection is established. An endeavor has been made to take advantage of this feature in the control measures undertaken by impressing upon stock breeders and dairymen the importance of building up their herds by a breeding rather than a purchasing process, and, in the event of its being necessary to introduce new animals, of the care necessary for the avoidance of danger of infecting the original stock. Control measures based upon sanitation have been advocated where the disease is already present.

Correspondence has furnished a means of supplying a certain amount of information, but efforts have also been made to reach those to whom the subject is vital by presenting exhibits and talks at many of the meetings of the stockmen's and dairymen's associations. The preparation and distribution of a Farmers' Bulletin (No. 790) has been the means of disseminating widely such facts in regard to abortion as have been considered of most practical value to the stock breeder and dairyman.

The application of control measures under herd conditions has received more attention than during previous years. The bureau has under observation at the present time 20 herds of cows, comprising approximately 3,000 animals, where different methods are being used. In a number of these herds efforts have been made to reduce the losses from abortion by applying sanitary measures alone. Bacterin treatments have been employed where a test of the animals has indicated that the infection has existed in the herd for only a limited period. In those herds where a large percentage of the animals have given positive reactions to the serum tests and abortions have been frequent for a number of years an effort has been made to develop an immunity or tolerance to the infection by the subcutaneous injection of nonpregnant animals, two months at least before breeding, with large doses of living abortion organisms, a method described by the Board of Agriculture and Fisheries of England as having been found effective. A sufficient length of time has not yet elapsed to estimate the value of these various methods. An objection to the latter control measure has been the danger that animals so treated may be actively infected and capable of disseminating the disease if introduced into clean herds. A further study of this feature is contemplated.

Many animals treated with bacterins have been tested at frequent intervals following the treatment in an endeavor to determine whether the injection of heavy suspensions are more efficient than those less dense in causing the development of agglutinins and complement-fixing bodies. Results have shown that animals receiving the same treatment respond in a variable manner, indicating that individuality plays an important part. Heavy suspensions have usually been found more efficient in increasing the agglutinating properties of the serum, however, as well as in prolonging the reacting period. Whether immunity is conferred, and whether the serum reactions may be utilized for estimating the degree of immunity, is yet to be determined.

Three samples of blood serum from buffalo cows of the Yellowstone National Park herd were received with the request that the serum tests for abortion be applied. Two of the animals had aborted. Serum from these gave positive reactions with an agglutination fluid prepared with the *Bacillus abortus* Bang. The third case was negative. It thus appears that the bacillus mentioned is pathogenic for this species of animal.

ANTHRAX INVESTIGATIONS.

Experiments with anthrax serum demonstrated that the immunizing and curative principle can be obtained in a more concentrated and refined form through fractioning of the serum with ammonium sulphate, as is done in the case of diphtheria and tetanus antitoxins. The results of this work are contained in a paper entitled "Immunity Studies on Anthrax Serum," published in the *Journal of Agricultural Research*, volume 13, No. 2.

During the year some experiments were undertaken to determine the value of bichlorid of mercury in the disinfection of anthrax-infected hides. Several infected hides were treated with different strengths of bichlorid solution and subsequently put through the regular tanning process. Samples for laboratory examination were taken every 24 hours during the time the hides were in the bichlorid solution and in the subsequent lime or lime and sodium sulphid solution, a total of 11 days. The results obtained were similar to those recorded hereafter by the Biochemic Division.

Laboratory examinations for the diagnosis of anthrax have been made from time to time of specimens received from various sections of the country. A considerable quantity of anthrax serum and spore vaccine has been prepared and furnished to various State live-stock officials for use in outbreaks of the disease. Anthrax serum has been supplied for the treatment of a number of cases of the disease in man with very satisfactory results.

VESICULAR STOMATITIS.

Microbiologic investigations of vesicular stomatitis have failed to shed any light on its causative agent. Repeated cultural studies of fresh vesicular fluid drawn under aseptic precautions from experimentally infected horses and from field cases have resulted in the isolation of a variety of microorganisms, including micrococci, several short rod-shaped bacilli, some of which take bipolar stain, a large Gram-negative spore-bearing rod, and a fungus. Horses and

calves were subjected to inoculations with cultures of these several organisms both intravenously and by scarification of the epithelial covering of the tongue and inner surface of the lips, but in no instance was the inoculation successful. An inoculation test of a small micrococcus isolated and cultivated under strict anaerobic environment proved it to be innocuous to horses and calves. Finally fresh vesicular fluid passed through a Berkefeld (N) filter was completely divested of all infectious qualities as determined by inoculation tests of the filtrate in six different experiments.

Microscopic examination of fresh vesicular fluid by dark-field illumination revealed the presence of micrococci and in addition small bodies with refractive coverings which were very similar in appearance to the spores of a fungus isolated on egg medium from a sample taken from a case of vesicular stomatitis.

Through the courtesy of Dr. James Gregg, of the British Remount Station at Newport News, Va., several cultures of a microorganism which he had isolated from a case of vesicular stomatitis in a mule, and with which suspicious symptoms of the disease were induced in other mules, were obtained for study. With this organism, which proved to be a facultative anaerobe and very slow to develop on any medium, we were unable to infect horses or calves by direct inoculation of large amounts of the culture.

OIDIOMYCOSIS IN CATTLE.

A number of specimens of bovine bronchial and mediastinal lymph glands were received from the meat-inspection stations for examination for actinomycosis. Upon microscopic study of purulent material from the lesions in these glands it was found possible in only a few instances to demonstrate actinomyces colonies, although in all cases the gross changes appeared quite typical of actinomycosis. In the larger number of specimens examined numerous minute spherical bodies were observed which were subsequently proved to belong to the genus *Oidium*. Experiment animals, including guinea pigs, rabbits, dogs, cattle, sheep, and swine inoculated with cultures of this fungus were all found to be susceptible subjects, their degree of susceptibility varying in the order named. The lesions produced by this oidium were very similar both macroscopically and histologically to those caused by inoculation with the tubercle bacilli, and should accordingly be classed among the infectious granulomata.

FORAGE POISONING.

Further experiments on animals to determine the relation of *Bacillus botulinus* to forage poisoning were confirmative of the results obtained last year, but opportunity to study only a few cases of the spontaneous disease was afforded. Search was made for the bacillus in these cases, but its presence was not demonstrated.

Feeding experiments with silage inoculated on the surface with this bacillus were started five months after the silage had been inoculated and resulted in the death of the experimental horse in two days. Another horse fed from another barrel of silage inoculated at the same time 2 feet below the surface and likewise held for a period of 5 months showed no ill effects. Later experiments, however, showed

that this animal possessed a high degree of immunity to botulinus infection.

The outcome of the year's observations tends to strengthen the theory that *Bacillus botulinus* is the factor to be reckoned with in many cases of forage poisoning; however, definite proof was not obtained.

MAMMITIS.

An effort has been made to study the effects of autogenic bacterins upon cases of mammitis or garget. Bacteriological investigations have shown that many cases arise in which no streptococci are present. Cases that are due to the presence of streptococci appear to be benefited by the application of bacterins subcutaneously. Another form of treatment that has recently gained favor is the gentle inflation of the affected quarter or quarters of the udder by means of the milk-fever syringe used for inflating the udder in cases of milk fever. This method is to be tested more fully.

DOURINE.

The complement-fixation test has continued to be extensively employed for the diagnosis of dourine, 49,585 samples of serum being tested, 1,225 of which gave positive reactions to the test, a percentage of 2.47.

During the year three colts were born to dourine mares at the Bethesda experiment station. These mares had been shipped in from Montana several years previously for observation and experimental work. Complement-fixation tests on the serum of the colts demonstrated the presence of natural immune bodies in the blood of these animals, which, however, completely disappeared before the animals had reached the age of 6 months.

TESTS FOR TUBERCULOSIS.

During the past year 59 cattle reacting to the tuberculin test were slaughtered under Federal supervision, in which no lesions of tuberculosis were found at the time of making a post-mortem examination. Tissues from these animals were submitted to laboratory tests in the Pathological Division, at which time investigations showed that tubercule bacilli were present in the glands of 34 of the suspected cattle, while none were detected in 25 of the specimens submitted. It is worthy of note that in 4 reactors from the Pacific coast the only visible lesions of tuberculosis present at time of slaughter were nodules in the subcutaneous tissues of the legs below the knee or hock. These nodules varied in size from one-fourth to three-fourths of an inch in diameter, several nodules being present on each affected leg.

DESTRUCTION OF TETANUS ANTITOXIN BY PROTEOLYTIC ENZYMES.

As part of a general study of antitoxins, aimed at the determination of their chemical nature, their preparation in the pure state, etc., a study was made of the destruction of tetanus antitoxin by proteolytic enzymes. Investigators do not agree as to whether antitoxins administered by mouth are destroyed in the digestive tract.

The destruction was studied in the following way: Tetanus antitoxin and tetanus serum were digested by trypsin and sodium carbonate in some mixtures and by trypsin alone in others. The extent of protein digestion was determined by chemical methods; the amount of antitoxin remaining was determined by inoculation tests on guinea pigs.

The following results have been obtained. In mixtures in which the proteins were digested, antitoxin was destroyed. In mixtures containing sodium carbonate only, digestion did not take place, but antitoxin was destroyed to practically the same extent as in the digested mixtures. This shows that under certain conditions antitoxin may be destroyed while the associated proteins remain intact, a new and unexpected result. The destruction is a slow chemical reaction; in one experiment 20 per cent of the antitoxin remained after 18 days' digestion.

GLANDERS.

Cooperative work was done in the control of glanders in various States. The complement-fixation test was applied to 1,252 samples of serum forwarded by State officials and practicing veterinarians, 244 of which gave positive results to the test, a percentage of 19.4.

The technic of the conglutination test for diagnosis was improved, and a number of samples of serum were tested simultaneously by both complement-fixation and conglutination with good results.

A mallein prepared from strains of *Bacillus mallei* isolated from glanderous lesions in mules was tried out on mules affected with glanders with the idea that a more specific reaction might be obtained than with the ordinary mallein. A sufficient number of tests has not been made, however, to warrant any definite conclusions.

OTHER RESEARCH WORK.

The rôle of *Bacterium pyogenes* in lesions in cattle and swine has received considerable attention. A paper on "Suppuration in Cattle and Swine Caused by *Bacterium Pyogenes*" has been published and a second paper has been prepared.

Work on the etiology of polyarthritis in pigs has been continued and material for publication is nearing completion.

RABIES.

Examinations for rabies were confined to specimens from the District of Columbia, Maryland, Virginia, West Virginia, North Carolina, Kentucky, and Montana. One hundred and twenty-nine suspected cases were received for laboratory diagnosis. These included 110 dogs, 9 cats, 5 cattle, 3 horses, 1 mule, and 1 rabbit. Out of this number 61 dogs, 2 cats, 3 cattle, 1 horse, and 1 mule proved positives. In every instance where a person had been bitten, animal inoculation was resorted to when the microscopic findings were negative.

POULTRY DISEASES.

Outbreaks of poultry diseases in various sections of the country resulted in a large number of domesticated birds or their carcasses being received for examination. The nature of these diseases was

determined by laboratory study, and advice was given on methods for eradication.

Material received gave opportunity for special study of infectious leukemia, fowl typhoid, and entero-hepatitis of turkeys. A protozoan organism similar in type to the coccidium but very much larger was found in two outbreaks of coccidiosis in baby chicks. These outbreaks were characterized by their acuteness and by marked intestinal hemorrhage. Research with the limited material at hand has not led to the identification of the organism.

The intradermal test for the detection of *Bacterium pullorum* infection in fowls was improved by the employment of a product precipitated with absolute alcohol from a bouillon culture of the organism and subsequently dissolved in a volume of carbolized distilled water equal to one-fifth the original volume of the culture. The test compared favorably with the agglutination test and was much simpler and less expensive to conduct. Work on this subject was reported in Department Bulletin 517, "An Intradermal Test for *Bacterium Pullorum* Infection in Fowls."

Experiments on the prevention and treatment of white diarrhea of baby chicks due to *Bacterium pullorum* infection, by means of an antiserum, gave negative results.

AUTOPSIES ON WILD ANIMALS.

Within the year 122 specimens of wild animals from the National Zoological Park were received for post-mortem examination. This material included a rather wide variety of species belonging to the three classes, reptiles, birds, and mammals. Of 6 reptiles, 3 were affected with enteritis, 1 with intestinal necrosis, 1 with multiple tumors, and 1 was undetermined. Of 71 birds, 14 were affected with enteritis, 3 with gastro-enteritis, 1 with fibroma of intestines, 3 with pneumonia, 2 with anemia (cachexia), 2 with hemorrhage, 9 with tuberculosis, 6 with aspergillosis, 1 with septicemia, 20 with quail disease, and 10 were undetermined. Of 45 mammals, 9 were affected with enteritis, 1 with gastritis, 12 with gastro-enteritis, 3 with peritonitis, 4 with pneumonia, 5 with anemia (cachexia), 1 with hemorrhage, 4 with tuberculosis, 1 with septicemia, 1 with uremia, 2 had been killed as unfit for exhibition, and 2 were undetermined. In several instances in which bacteriologic examination of tissues of animals were made the causal organisms of the affections were definitely determined.

CONTROL OF BIOLOGICAL PRODUCTS.

Although the regulatory work in connection with the supervision of veterinary biological products under the virus-serum-toxin law of 1913 is performed by the Office of Virus-Serum Control, the Pathological Division has continued to carry out the testing of the various products other than mallein, tuberculin, and hog-cholera serum and virus. During the year 281 samples were examined, of which 21, representing 12 products made by 8 establishments, were found unsatisfactory.

BLACKLEG VACCINE.

The preparation and free distribution to stock owners of vaccine for the prevention of blackleg in cattle has been continued, 6,050,195 doses having been sent out during the fiscal year, an increase of more than half a million doses.

INVESTIGATIONS OF PLANT POISONING OF STOCK.

The work in the investigation of plant poisoning of live stock involves (1) the collection and collation of information in regard to poisonous plants and the conduct of correspondence relating to this subject, (2) the investigation of cases of poisoning with reference to determining the plants producing the disease and of giving advice in regard to methods of treatment of affected animals and of prevention of losses, and (3) the experimental investigation of the effects of poisonous plants. The research work is carried on in part in the laboratories in Washington and in part in field stations. The principal field station at present is on the Fish Lake National Forest, about 16 miles from Salina, Utah. This station was erected by the Forest Service and comprises pastures, feeding corrals, and necessary buildings. Laboratory facilities are provided and detailed experimental work is carried on with animals suffering from poisonous plants upon the range.

The general plan of the experimental work includes tests to prove whether suspected plants are actually poisonous, experimental feeding to determine the symptoms and pathology of poisonous animals, and the study of possible remedies and of the methods by which poisoning can be prevented. With the feeding experiments is conducted a chemical study of the plants, in order that there may be a scientific basis for possible remedies. Some of the studies are made difficult by the fact that many of the so-called poisonous plants are not acute poisons and cause trouble only as they are eaten in somewhat large quantities and under certain peculiar conditions. In some cases the plants are poisonous only at certain seasons, while in others they affect one kind of domestic animals but are harmless when eaten by others.

The plants which have been the subject of special investigation during the past season are the western sneezeweed (*Dugaldia hoopesii*), which occasions heavy losses of sheep on the national forests of Utah, and oak brush, which is reputed to kill cattle in many sections of the West. In connection with the oak-brush study a station was maintained at Monahans, Tex., for two months for a study of the so-called shinnery oak poisoning. Experimental work has been conducted also on pingue (*Hymenoxys floribunda*), yellow weed (*Gutierrezia diversifolia*), aconite, the larkspurs, and on *As-tragalus diphysus*, the loco plant particularly destructive to horses and cattle in New Mexico, Arizona, and southern Utah. Milk sickness, a disease destructive to cattle in the mountains of North Carolina and common in many other States as far as New Mexico, also has been a subject of investigation.

Some of these investigations are incomplete, and final results can be published only after further prolonged study. Others, like the oak brush, may be considered as practically finished, while in other cases the material at hand is sufficient for preliminary reports which will aid in reducing the losses.

BIOCHEMIC DIVISION.

M. DORSET, *Chief.*

HOG-CHOLERA INVESTIGATIONS.

The work on hog cholera has consisted almost entirely of research work on various problems connected with the control of that disease. This work was carried out under three major projects, which are reported upon separately, as follows:

METHODS OF PRODUCING IMMUNITY AGAINST HOG CHOLERA.

In the report for the preceding fiscal year it was stated that a method of separating the blood corpuscles from the serum of defibrinated hog's blood had been devised. This offered what appeared to be a practicable method of producing a serum which could be subjected to heat and thus effectively sterilized against foot-and-mouth disease. Experiments with this method have been continued. It has been found that clear anti-hog-cholera serum produced by the bean-salt method, heated at a temperature sufficient to destroy foot-and-mouth disease virus, retains its potency at least as long as eight months. This is in accord with observations made by others on diphtheria antitoxin and confirms the view that the heating does not shorten the time during which the serum will remain potent when kept under proper conditions. Several large commercial producers of anti-hog-cholera serum have adopted this method and have operated it successfully for more than a year. At first difficulty was encountered in preparing from beans an agglutinin which would keep in good condition for considerable periods of time. This is a matter of practical importance to serum producers. Experiments during the year have resulted in the development of a method for producing an agglutinin which, either in the form of a powder or in solution, will keep in good condition for longer periods. A description of the method was published in the *Journal of the American Veterinary Medical Association* for February, 1917. (Vol. L, N. S. 6, pp. 699 to 702.)

In the investigation of various plant seeds with reference to their suitability for producing agglutinins, extracts from 54 different varieties of seed were tested on hog blood, horse blood, and ox blood. The seed represented all of the procurable varieties of beans and many varieties of peas and lentils, as well as peanuts and acorns. None of the extracts agglutinated ox blood. Most of the extracts from beans agglutinated hog blood and horse blood, while extracts from the jack bean, asparagus, lentils, and black-eyed pea agglutinated only horse blood.

Chemical tests indicate that the agglutinins derived from beans are probably of the nature of albumins. They are destroyed by heat at 80° C. (176° F.). A full report of these experiments is being prepared for publication.

As long as hog-cholera serum is prepared in the form of defibrinated blood there may at times arise, owing to outbreaks of foot-and-mouth disease, or for other reasons, the necessity to heat or to concentrate the antitoxin. Previously such refinement has been carried out by precipitating the globulins by means of ammonium sul-

phate. Such a method is complicated, and there is always left in the finished product considerable amounts of ammonium sulphate, which is regarded as undesirable. During the past year a new method for heating and concentrating hog-cholera defibrinated blood antitoxin has been developed. This consists in heating the old defibrinated blood after dilution with a strong solution of sodium chlorid. This is followed by filtration and subsequent precipitation of the serum proteid, including the antitoxin. Tests of products obtained in this way have indicated that the process is practicable. The details of this process will be published later.

MODES OF SPREAD OF HOG CHOLERA.

Extensive experiments to gain further knowledge of the modes of dissemination of hog cholera have been carried out along a number of different lines. In this report there are included only those experiments which have proceeded to a stage where a statement of results is warranted.

Repeated experiments have shown that the blood of pigs that have previously been inoculated with the virus of cholera becomes infectious for others within 24 hours. The urine and feces contain the infection usually in 48 hours, and the secretions of the eyes and nose become infectious by the third day following infection. Rarely, if ever, do pigs show visible symptoms of cholera earlier than four or five days after infection; therefore these experiments show that infected pigs are capable of transmitting disease before they themselves show any visible symptoms of illness.

Experiments were carried out to determine whether by mere contact infected pigs are capable of transmitting hog cholera at all stages of the disease or whether there are certain periods, early or late, when the disease is not contagious. These experiments were performed by exposing healthy, nonimmune pigs to infected pigs for short periods of time at different dates following infection. It was found that hog cholera was not transmitted by contact during the first 48 hours following infection. Subsequent to that date and up to and including the twenty-first day after infection the disease was conveyed regularly to the nonimmune pigs. These experiments show that hog cholera is contagious at practically all stages, even including the stage of incubation. They indicate also that an infected hog is likely to remain a source of danger until the time of complete recovery.

It is very important to farmers, as well as to persons engaged in live-stock sanitary work, to know whether hogs which have recovered from an attack of hog cholera are likely to be "carriers" of the disease. During the past year four hogs which had recovered from distinct and undoubted attacks of cholera were tested for infectiousness by placing each one in a pen with healthy, nonimmune hogs, and in each case blood was drawn from the recovered pigs and injected into nonimmune pigs. In no case was hog cholera produced in the exposed animals, which were later proved to be susceptible to cholera. These experiments do not show that recovered pigs may not at times be carriers of hog cholera, but they do prove that all recovered pigs are not carriers, and they indicate that the likelihood of recovered hogs being carriers of hog cholera is not great.

The belief that birds play an important part in the spread of hog cholera led to some experiments with pigeons. Suitable pens were prepared facing each other, and the space between was inclosed by wire netting. The front of each pen was left open, so that pigeons which were placed in the inclosed space between the pens could have easy access to the pens on either side. In one pen pigs sick of cholera were kept and in the other there were healthy, nonimmune pigs. When the sick pigs died they were replaced with others, so that the disease was kept constantly present in one of the pens, and this pen was not cleaned during the course of the experiment. The healthy pigs were changed from time to time. The pigeons constantly flew from the infected pen to the opposite pen containing the well pigs, which was only 10 feet distant. In the different experiments healthy pigs were exposed to infection through the medium of the pigeons for from 30 to 40 days. In no case was the disease transmitted by the pigeons, although it is evident that every opportunity was afforded for this to occur. The exposed pigs were proved susceptible by subsequent exposure to cholera. While these experiments can not be said to prove that it is impossible for pigeons to carry hog cholera, it seems fair to conclude that the disease is probably not often carried from one farm to another in that way.

Rats were fed for a number of days on meat from pigs that had died of hog cholera, and later the rats were killed and fed to susceptible pigs, but in no case was cholera conveyed in this way.

A number of experiments were carried out to determine the length of time that premises are likely to remain infectious following an outbreak of cholera. The attempt was made to simulate as far as possible ordinary farm conditions. Pens of different construction were used, some having dirt floors, others concrete floors, and others wooden floors. All of the pens were so constructed or so situated as to be almost wholly protected from sunlight. Sick pigs were placed in these various pens; in some the pigs were allowed to die before the pen was used for purposes of exposure; in others the pigs were removed during the height of the disease after they had been plainly sick of cholera for a number of days. Susceptible pigs were placed in these different pens at different periods of time after the removal of the sick pigs. The first experiments were carried out during the summer and fall, whereas the second set was carried out in December after the weather had become cold. The results may be briefly summarized as follows:

In the warm weather of the late summer and early fall healthy pigs did not contract cholera when placed in pens 24 hours after they had been occupied by pigs sick of cholera. In the colder weather of the late fall and early winter the pens remained infectious for much longer periods. There was no apparent difference in the duration of infection in the various types of pens. The results of these experiments are surprising, as the general opinion of those who have studied hog cholera has been that the virus survives for many months. As these experiments are considered of great importance, they are being continued and repeated.

In another series of experiments carcasses of hogs that had died of cholera were exposed in the open in a metal wheelbarrow, where they were protected from the direct sunlight, while others were buried at a depth of 2 feet from the surface of the ground. Portions

of these carcasses were tested at intervals by chopping up some of the meat and feeding it to nonimmune pigs. It was found that in summer the infectiousness disappeared from the buried and unburied carcasses alike as a rule within 7 days, there being only one exception to this. In winter, however, the virus remained alive and active for several months. These experiments thus agree in the main with those with infected pens. The infectiousness is of short duration in summer but continues for long periods in winter. The natural conclusion is that the processes of putrefaction and decay destroy the vitality of the hog-cholera virus.

It has been generally believed that the hog-cholera contagion is commonly and frequently conveyed on the shoes of farmers and on the wheels of wagons and other farm equipment. A number of experiments have been carried out to determine the likelihood of the disease being carried in such a manner. This work is incomplete, but the experiments already finished permit a partial report. Pens of pigs affected with cholera were maintained at a distance of from 50 to 100 yards from pens which contained healthy, nonimmune pigs. Two men daily entered the pens with the sick pigs, and after walking through the pens and handling the sick animals they walked immediately to the pens containing the healthy animals a short distance away and entered the pens with them. In one case healthy pigs were exposed daily in this manner for 60 days in all and yet remained practically well. These experiments are being continued, yet sufficient data have already been obtained to make it clear that hog cholera is not readily conveyed on the feet of attendants and that probably this channel is not so important in spreading the disease as has been generally believed.

CAUSE OF HOG CHOLERA.

Extensive bacteriological studies have been made of the organs and body fluids of sick hogs in order to discover the exact nature of the virus of hog cholera. Many interesting observations have been made, but no final conclusion has been reached.

PRODUCTION OF ANTI-HOG-CHOLERA SERUM.

During the fiscal year there was produced approximately 3,000,000 cubic centimeters of anti-hog-cholera serum, of which about 550,000 cubic centimeters was sent out for use by inspectors in the field. Approximately 24,000 cubic centimeters of virus was supplied for use with the serum in applying the simultaneous inoculation against hog cholera. Numerous commercial establishments were supplied with small quantities of standard virus for use in serum production.

DIPS AND DISINFECTANTS.

The laboratory of dips and disinfectants received for examination 300 samples of live-stock dips, disinfectants, and miscellaneous materials.

During the calendar year 1916 there were sent out the following test outfits and supplies for making tests of dips in the field: Two hundred and ninety test outfits for arsenical dips, supplies for making

208,000 arsenical tests, 31 test outfits for lime-sulphur dips, supplies for making 5,900 lime-sulphur tests, supplies for 2,400 nicotin tests. In addition supplies for more than 300,000 tests were sent out during the first six months of 1917.

Laboratory investigations have been made of the suitability of various commercial forms of sodium carbonate for use in preparing arsenical solutions. Certain other forms may be used in place of sal soda under proper control. A report has been made and advice will be sent to the field forces.

A modified procedure for preparing "self-boiled" arsenical solution, intended to make the process shorter and more certain, has been developed and is being tried in the field.

Further work has been done upon the disinfection of hides. Further studies of the disinfecting value of mercuric chlorid under different conditions have been made, and it has been found that this substance in a solution of 1 to 5,000 applied to hides for six days is sufficient to destroy the infection of anthrax on the hide, provided this soaking is followed by five days' exposure to limes of the usual strength. It has further been found that the effectiveness of mercuric chlorid is influenced by sodium chlorid, which in amounts up to 2 per cent aids the action of the mercuric chlorid, while more than 2 per cent appears to hinder its action. Although hides may be disinfected by exposure to 1 to 5,000 mercuric-chlorid solution for six days followed by five days' exposure in the limes, this method does not serve satisfactorily to disinfect the effluent of the plant.

Extensive studies have been made of various methods for treating the effluent of tanneries so as to eliminate the danger of the dissemination of anthrax. The experiments with the use of chlorin gas indicate that 50 parts of the gas per million parts of the effluent is not efficient for disinfecting tannery effluents, the amount of chlorin required being in most cases probably from 300 to 400 parts per million of effluent. It appears that exhaust steam from tanneries may be used effectively to sterilize the effluent. Numerous experiments have shown that momentary heating at 100° C. (212° F.) destroys the anthrax spores in infected soak water from hides. Further work is being done along this line, as the observations made in the bureau laboratories indicate that the anthrax spore is killed by a shorter exposure in boiling water than has been reported by other observers. The disinfection of tannery effluents by heat and by chlorin has been studied in cooperation with the sanitary engineer attached to the Meat Inspection Division.

STUDIES OF CHANGES IN MEATS DURING STORAGE.

For the most part the work on the changes in meats during storage has consisted of a study of the enzymes which occur naturally in muscular tissue. Exact knowledge of such enzymes is of fundamental importance in a consideration of the changes that take place in meats during storage. Two problems were studied—(1) the function of muscular tissue in urea formation, and (2) the glycolytic properties of muscular tissue. The results of studies of the former indicate that although there is a very considerable accumulation of the precursors of urea in muscular tissue during autolysis, urea itself is not formed. These facts indicate that muscular tissue is probably

not an important site of urea formation. The results of the experiments in the second problem taken as a whole indicate that muscular tissue has considerable glycolytic properties; that is, ability to cause the disappearance of carbohydrates, and that these properties are most active for a few hours following the death of the animal. Although carbohydrates are broken down, the process does not proceed to the complete oxidation of sugar to carbon dioxide and water, but rather to the formation of an intermediate product, which in all likelihood is lactic acid. Papers reporting the results of these investigations have been prepared for publication in a scientific journal.

TUBERCULIN AND MALLEIN.

During the fiscal year there were furnished to various State, county, and city officials 600,702 doses of tuberculin for testing cattle for tuberculosis and 395,455 doses of mallein for testing horses and mules for glanders. Arrangements have been made for these laboratories to supply sufficient mallein to meet all of the needs of the War Department.

Laboratory studies have been made of processes for refining and concentrating tuberculin, and progress has been made in the production of a tuberculin which is considerably more potent than that ordinarily produced. Some of these refined products have been applied to the ophthalmic diagnosis of tuberculosis.

ZOOLOGICAL DIVISION.

B. H. RANSOM, *Chief.*

ROUNDWORMS OF SHEEP.

In experiments at the farm near Vienna, Va., leased by the bureau for carrying on investigations of stomach worms and other similar parasites of sheep, it was found that lambs born in the spring could be carried through the summer season without material injury from internal parasites if the flock was moved every week after the grazing season began (about May 1) to fresh areas of ground, which had been prepared for grazing by planting with rye, oats, millet, or cowpeas, and if the mothers were dosed once a month with 100 cubic centimeters of 1 per cent solution of copper sulphate. The dosing of the mothers was done for the purpose of destroying stomach worms, and thus reducing the danger of infecting the lambs from this source. After weaning the lambs in July they were separated from their mothers, and during the remainder of the summer were kept moving over fresh-planted pastures, the hurdles being changed every week. In marked contrast, other lambs which were kept during the summer with their mothers in a permanent pasture nearly all died and showed on post-mortem examination serious infestation with internal parasites, particularly stomach worms.

Sheep born in the spring of 1915 and carried through the remainder of the year by following various methods of handling were thereafter maintained in a thrifty condition by occasionally moving them to fresh-planted pastures during the spring, summer, and autumn of 1916 and dosing them once a month with 100 cubic centi-

meters of 1 per cent copper sulphate solution. Monthly fecal examinations have shown that the number of parasites among these yearlings was kept down to a low figure.

A few wethers born in the spring of 1915 have been kept constantly in the stable since birth, and upon monthly fecal examinations have never shown more than a few parasite eggs and frequently have shown no eggs at all, indicating their practical freedom from parasitic infestation. Under these conditions their growth has been vigorous and their health excellent.

It was again observed, as in the year before, that in all the sheep at the Vienna station the number of stomach worms and similar parasites greatly diminished during the winter.

TREATMENT AND CONTROL OF EXTERNAL PARASITES.

CATTLE LICE.—Sufficient experimental work on cattle lice has been completed to justify publication on this subject, and a manuscript has been prepared for a Farmers' Bulletin. Three species of lice—two sucking and one biting—have been found to be of common occurrence on cattle. The greatest losses have been found to occur in young stock and poorly nourished old animals. Dipping has proved the best method of treatment. Two dippings are necessary for eradication in most cases; sometimes more than two are required, especially in the case of the short-nosed cattle louse. The most suitable interval between dippings seems to be 15 or 16 days. Arsenical dips, coal-tar creosote dips, and nicotin solutions have given good results as remedies.

HOG LICE.—Various dips were tested in Utah and Colorado as remedies for hog lice. In some cases eradication was accomplished by a single dipping, but generally two dippings were required, 15 to 16 days being a suitable interval. The following dips were found to be efficacious: Coal-tar creosote, cresylic acid (compound solution of cresol U. S. P., diluted 1 to 100), arsenical dip (low strength, about 0.18 per cent arsenic trioxid), nicotin (0.07 per cent), and kerosene emulsion (10 per cent). Under varied conditions it was observed that hog lice survive only three or four days away from their host, so that places in which infested hogs have been kept may be considered practically free from infection within a week after the removal of the hogs, although theoretically there would still remain a possibility of infection from young lice hatching from dislodged eggs.

SHEEP AND GOAT LICE.—Experiments in the treatment of sheep and goats for lice have been carried on in Utah, New Mexico, Texas, and California. Some of these experiments were arranged on a small scale; in others large numbers of animals were dipped under practical field conditions. The lice were more difficult to eradicate from animals on the open range than from those confined in pens and fed hay and grain. Sucking lice appeared to cause more injury than biting lice, although sheep and goats grossly infested with lice of any species failed to thrive and the irritation to the skin caused the animals to rub and lose wool. Two dippings were found necessary for eradication, with an interval of 14 to 16 days. Biting lice, however, which appear less difficult to destroy than sucking lice, were frequently eradicated by one dipping. Successful results were ob-

tained from coal-tar creosote dips, arsenical dip (low strength, about 0.18 per cent arsenic trioxid), and nicotin dip (0.07 per cent) with 2 per cent flowers of sulphur.

SHEEP SCAB.—Experiments on the transmission of scab from one sheep to another indicate that sheep scab spreads more rapidly and certainly to healthy animals when they mingle with infected sheep than by any other method of exposure. Yards, corrals, etc., previously occupied by scabby sheep appear less dangerous as a source of infection than is commonly supposed, and it is probable that under winter conditions very little, if any, risk of infection remains after sheep have been excluded from such places for 30 days. The form of scab affecting the Rocky Mountain sheep, by some investigators considered a distinct disease, appears to be transmissible to domestic sheep. Under experimental conditions it was found that scab even in advanced stages could be cured by dipping affected sheep in flowers of sulphur suspended in water. The lack of a method of insuring proper application, however, precludes the practical use of a simple suspension of flowers of sulphur in water as a remedy for scab. One reason for the general high efficacy of lime-sulphur dip in the treatment of sheep scab under all sorts of conditions appears in the fact that it was found possible to cure the disease with dips containing considerably less sulphid sulphur than that required by the bureau regulations. In other words, the margin of safety in the efficacy of the dip is such that even in cases in which for any cause the dip is below standard it is likely to be sufficiently strong to effect a cure.

OX WARBLER.—Results of extensive observations in the South, where arsenical dip is systematically used for the eradication of cattle ticks, show that as a rule a material reduction occurs in the number of warbles infesting cattle, sometimes amounting almost to complete eradication. In experiments in Colorado, New Mexico, and Utah, however, repeated applications of arsenical dip during the spring and summer failed to prevent the appearance of warbles in the backs of the cattle the following winter. This failure may have resulted from the fact that dipping was not begun until after the appearance of the winged stage of the warble flies, or from the fact that the cattle were not dipped in the winter after the warbles had reached the back and had perforated the skin. It still remains to be determined whether the greatest efficiency of the arsenical dip is obtained when the dipping is done during the fly season or when it is done after the warbles have reached the back.

SPINOSE EAR TICKS.—As a result of experimental work and field investigations in Texas, New Mexico, and California it has been determined that ordinary tick remedies will not destroy ear ticks. Bland oils and crude petroleum, usually recommended for the destruction of ear ticks, are not efficacious. No satisfactory remedy has been found that can be applied in the form of a dip. Hand treatment, in which the remedy is injected into the ears of infested cattle, is the only satisfactory method which has been discovered for freeing them of infestation. It is necessary to clear the ear passages before treatment when they are clogged with masses of ticks and wax. An oil can or syringe fitted with about 4 inches of rubber tubing proved a useful instrument for the application of remedies. One of the

best remedies tested was pine tar 2 parts, cottonseed oil 1 part. Animals kept on infested premises after treatment usually became reinfested within one or two months. The best results were obtained from treatment administered during the late autumn or early winter.

CATTLE TICKS.—Tests of a lime-sulphur-arsenic mixture in Oklahoma and Texas showed that it was unsatisfactory as a remedy for cattle ticks.

The field test for arsenic employed by the bureau shows the amount of unoxidized arsenic in a bath, but does not show the oxidized arsenic. Owing to the tendency of arsenical baths to undergo oxidation, replenishing a bath on the basis of the strength shown by the field test may result in a dipping solution which contains a considerably higher percentage of arsenic than the field test indicates, the additional arsenic being present in the more highly oxidized form. Further investigations of this question have confirmed earlier work in showing that if the unoxidized arsenic (arsenite) in a dipping bath is kept at a strength of about 0.2 per cent, additional arsenic in the oxidized form (arsenate) may be present sufficient to give a total arsenic content of 0.5 or even 0.6 per cent (in terms of arsenic trioxid) without injuring cattle. So high a percentage of total arsenic resulting from oxidation is not likely to occur under actual conditions, consequently the fact that the field test shows only the arsenic present in the unoxidized form is not of practical importance.

Tests of a material, apparently of vegetable origin, received from Guatemala, where it is said to be extensively used as a remedy for cattle ticks, showed that it had no effect when used in accordance with the directions given, which specified that certain amounts be injected intramuscularly several times at intervals of 24 hours. It was also claimed that the same remedy was a cure for Texas fever, but in view of its failure as a tick remedy it was not tested as a remedy for Texas fever. Another alleged remedy, which has been extensively advertised in some parts of the South, consisting essentially of common salt and sulphur compressed into blocks, to be placed in pastures for the cattle to lick, was tested in cooperation with the Insecticide and Fungicide Board and found to be without value as a tick remedy.

MISCELLANEOUS.—Experiments on hog mange and sarcoptic mange of cattle have been continued. Tests of several proprietary articles for which claims have been made as remedies for external parasites have been carried out in cooperation with the Insecticide and Fungicide Board. A Farmers' Bulletin (No. 798) on the sheep tick was issued during the year.

ANTHELMINTICS AND TREATMENT FOR INTERNAL PARASITES.

Various substances were tested with reference to their value as anthelmintics, including iodoform, commercial gasoline, petroleum benzin, copper sulphate, ether, santonin, turpentine, tobacco, thymol, spigelia, latex of *Ficus laurifolia*, oil of chenopodium, chloroform, oleoresin of male fern, and pelletierin tannate. The animals which were subjected to experimental treatment included sheep, hogs, dogs, cats, and chickens, and the parasites which were involved included various species of roundworms and tapeworms.

Most of the remedies tried failed to show a high degree of efficacy. Gasoline, commonly recommended for the treatment of sheep affected with stomach worms, given in repeated doses, had very little effect upon these parasites. It is possible that the difference between the gasoline of the present time and the higher grade of 15 years or more ago, when it first came into use for treating sheep to destroy stomach worms, would explain recent failures. In fact, it was found that petroleum benzin, which is very similar to the gasoline of a few years ago, gave better results. Copper-sulphate solution, however, seems preferable as a stomach-worm remedy; it is more easily administered, is cheaper, and is highly efficacious even in a single dose. Gasoline as formerly used was customarily given in three doses at intervals of 24 hours, mixed with milk, so that it was a very troublesome and rather expensive remedy to use. Chopped tobacco stems soaked in water and mixed with the feed, as recommended by Herms and Beach, of California, have given good results as a remedy for certain nematodes which commonly affect poultry. Oil of chenopodium has continued to give good results as a remedy for intestinal roundworms of hogs. Chloroform has proved to be a very efficacious remedy for hookworms in dogs, but experiments have indicated that it is not satisfactory for hookworms in sheep, because of its injurious effects on the sheep.

BLACKHEAD OF TURKEYS.

Investigations on blackhead in turkeys have been continued, but owing to difficulties encountered in obtaining suitable material and the small number of birds available for experimental purposes very little progress has been made.

COLLECTION OF PARASITES.

Several hundred specimens of parasites from the United States and abroad were added to the reference collection maintained by this division.

ZOOLOGICAL INVESTIGATIONS RELATING TO MEAT INSPECTION.

In continuation of the investigations on the effects of the curing process upon the vitality of trichinæ, repeated tests have been made of the methods permitted by the bureau for the preparation of pork products customarily eaten without cooking. In these tests no case has occurred of the survival of trichinæ in trichinous pork prepared following the methods permitted for such products. Other methods have also been tested, with favorable results, but the data collected have not been considered sufficient to justify their acceptance as adequate for the destruction of the parasites.

The results of former experiments have been confirmed by further investigations upon the effects of heat on trichinæ. The larval parasites die at 55° C. if the temperature is gradually raised to this point, and temperatures somewhat lower are fatal if maintained long enough.

Experiments on the effects of X rays have shown that trichinæ may be destroyed by massive applications of the rays, but whether the use of X rays can be made commercially practicable for the sterilization of trichinous pork has not yet been determined.

MISCELLANEOUS INVESTIGATIONS OF ANIMAL PARASITES.

Experiments have been carried out on the effects of injecting into animals material obtained from various species of metazoan parasites, such as body fluids and aqueous extracts or suspensions of their tissues, either fresh or dried and pulverized. These experiments were suggested by the recent work of Hadwen, of the Canadian Department of Agriculture, to whom the bureau is indebted for his collaboration during several weeks which he spent in the laboratories of the Zoological Division. In the experiments in this division the host animals used were cattle, horses, sheep, hogs, dogs, cats, rabbits, guinea pigs, turkeys, and chickens, and the parasites included nematodes and tapeworms of various species, ticks, lice, warbles, and bots. Few experiments were made on the ophthalmic and intradermal reactions, and the injections in most cases were given subcutaneously, occasionally intravenously. The conclusions reached in some respects are slightly different from those first expressed by Hadwen. Some of the more important are as follows:

Reactions of an anaphylactic type may be produced in cattle, sheep, and hogs by single injections of antigens prepared from various metazoan animal parasites.

In some cases the reaction may possibly be specific and dependent upon the existence of infestation with the species of parasite from which the antigen is obtained.

In other cases there is no relation between the reaction and the presence or absence of parasites of the species from which the antigen is obtained, and animals may react to parasites of species with which they are not liable to infestation.

Sheep are very susceptible to injections of crushed material, fluids, or extracts from certain metazoan parasites, irrespective of the presence of infestation with these parasites, and small quantities, which have no apparent effect upon guinea pigs and rabbits when injected intraperitoneally or subcutaneously, may, when injected subcutaneously, produce severe reactions in sheep, frequently terminating in death.

Sheep may respond repeatedly to subcutaneous injections, at intervals of a few days, of material from the same species of parasite, so that the reaction in sheep apparently differs from the ordinary anaphylactic reaction not only in the fact that a sensitizing injection is not required, but in that sheep recovering from one reaction are not thereafter for a considerable period of time insusceptible to further injections.

This work is believed to have an important bearing upon the many problems relating to the phenomena of anaphylaxis, and as Hadwen's reaction (that is, the response of animals to antigens prepared from metazoan parasites) in some cases appears to be specific, it may prove of practical utility in diagnosis.

In investigations of the gapeworm (*Syngamus trachealis*) examination of 635 chickens sold for food on the market at Washington during December, January, and February showed that none was infested with this parasite. On the other hand, examinations of 386 turkeys from the same market during the same period showed that 92, or 23.6 per cent, were infested. This indicates that compared to

turkeys adult chickens are relatively unimportant as carriers of the gapeworm.

The infectious larval stage of the parasite has been kept alive in moist media in the laboratory over a year, which shows that ground on which infested chickens or turkeys have been kept may retain its infectiousness for long periods of time.

It has been found that about two weeks are required for gapeworms to reach maturity and begin producing eggs after the larvæ have been swallowed by a chicken. In experiments chickens 10 days old when fed gapeworm larvæ all died within a month. They began to show symptoms of disease 8 to 10 days after infection, most of them dying between the tenth and fifteenth days, and all were found infested when examined post-mortem. Chicks 6 to 10 weeks old became infested, but not invariably, and, unlike the younger chicks, did not show marked symptoms. Whether any would have died as a result of infestation was not determined, as they were killed for examination two weeks after feeding gapeworm larvæ to them. In the case of adult chickens fed repeatedly with large numbers of gapeworm larvæ, less than one-fourth became infested, and usually only a very few worms were recovered.

With reference to the practical application of these results in the prevention of losses from this parasite, it is evidently very important that young chickens for the first few weeks of life be kept on clean ground; that is, ground free from gapeworm infection. Brood hens may be associated with them, but other chickens and turkeys should be rigidly excluded from places occupied or to be occupied by the young chicks. So far as known, ground once occupied by infested chickens or turkeys may remain infectious for several years. When chickens have reached an age of a month or six weeks they may be removed from the places reserved for their first occupancy, and thereafter it is unlikely that they will suffer seriously from gapeworms.

Claims recently made (Salzer, 1916) with reference to the action of serum from animals convalescent from an attack of trichinosis have been investigated and no evidence discovered that such serum has any effect in either preventing or curing the disease.

Recent experiments of Stewart, of the British Army, have been repeated in this division, and it has been found, as he found, that the eggs of the common roundworm of hogs (*Ascaris suum*) when fed to mice and rats hatch out, and that the larvæ undergo considerable development in these hosts, migrating to the liver, lungs, esophagus, and intestine, apparently in the order named. The larvæ were found also in other organs and locations. It seems likely that the development in rats and mice is simply an expression of the ability of the parasite to live for a limited period in another than its usual host, and that these animals do not in any way act as intermediate hosts as Stewart was inclined to believe. In the light of Stewart's investigations and those of this division it is probable that the larvæ which hatch from the eggs of these and similar parasites migrate rather extensively in their normal hosts, as they do in rats and mice, before they finally establish themselves in the intestine to continue their development to maturity. How much damage they may do in the course of their migrations is a question for future determina-

tion. Rats and mice which have been fed large numbers of the eggs of *Ascaris suum* commonly die in six to eight days after the feeding, at a time when numerous larvæ are found in the lungs.

MISCELLANEOUS DIVISION.

A. M. FARRINGTON, *Chief.*

The work of keeping records and conducting general correspondence regarding the personnel of the bureau has been conducted by the Miscellaneous Division. This includes correspondence regarding civil-service examinations for positions in the bureau, appointments to such positions, promotions, demotions, transfers, removals, the conduct of employees as to efficiency, the acceptance of outside employment, and other similar subjects. The division has kept in correspondence with the veterinary medical educational institutions of the United States and exercises a supervision of these institutions under the department regulations. Unclassified miscellaneous correspondence which does not come within the scope of work performed by other divisions of the bureau is also part of the work of this division.

BUREAU PERSONNEL.

At the beginning of the fiscal year the persons in the employ of the bureau numbered 4,013. During the year there were 880 additions to this number, made up as follows: Appointments, 794; transfers from other branches of the Government service, 38; reinstatements, 48. During the same period there were 682 separations from the service, as follows: Resignations, 334; deaths, 30; removals for cause, 11; transfers to other bureaus or departments of the Government, 39; all other separations, 268. This last item includes terminations of appointments by limitation or for administrative reasons, exclusive of separations for disciplinary reasons. At the end of the fiscal year the bureau personnel numbers 4,211, a net increase of 198 during the year.

During the year 13 civil-service examinations were requested and subjects and weights were furnished to the Civil Service Commission.

VETERINARY EDUCATION.

As reported last year, the Civil Service Commission has concurred in the plan to require veterinary colleges which wish their graduates admitted to civil-service examination for veterinary inspector to pursue a course of study in veterinary science for four years. To enforce this requirement it became necessary to revise the existing regulations and to demand after the fall of 1917 an additional year of study with an increased number of hours. On this basis new regulations were formulated and published as a circular in the Office of the Secretary of Agriculture, effective March 1, 1917.

The attendance of students during the last fiscal year at veterinary colleges has been less than formerly. This is due in part to the fact that most of these colleges by general agreement extended the course of study to four years instead of three years. The number of freshmen enrolled for the session beginning with the fall of 1916

was 637, against 1,233 for the preceding year, a decline of 51 per cent. Three colleges did not extend their courses, but this condition probably will not continue for another session, because by the revised regulations all veterinary colleges which wish to have their graduates eligible for the Government service must provide a four-year course. Notwithstanding the large general decrease in the number of entering students, the attendance at five colleges actually increased. This increase was principally at colleges which had instituted previously a four-year course. The combined attendance at all colleges was only 331 less than last year, or 2,661 against 2,992 students. The number of graduates was larger, 774 as compared with 734.

The institutions known as State veterinary colleges have raised the entrance requirements now to high-school graduation, and in the interest of higher education this should be adopted by all colleges, if the best results are to be obtained.

No veterinary colleges have been added to the accredited list since last year, and none have been removed. Although several State agricultural colleges are preparing to add a veterinary department, the final arrangements have not been completed. The number of accredited veterinary colleges is 21 in the United States and 8 in foreign countries.

EXPERIMENT STATION.

E. C. SCHROEDER, *Superintendent.*

The work of the Experiment Station at Bethesda, Md., was similar in character to that of previous years, and consisted of tests, studies, and investigations, made both independently and in cooperation with other divisions, concerning infectious diseases of domestic animals, and the provision of facilities, not obtainable in city laboratories, required by the other divisions.

INFECTIOUS ABORTION DISEASE OF CATTLE.

Tests proved that the injection of abortion bacilli into the vein of a pregnant cow as shortly as 11 days before the natural termination of gestation caused no observable disturbance and in no manner influenced parturition or the size and vigor of the calf. It did, however, cause the infection of the placenta with abortion bacilli. The same was found to be true when abortion bacilli were injected into pregnant cows respectively 19, 28, and 47 days before expected parturition. When the injection was made 83 days before parturition the calf produced was very weak.

As the previously recorded investigations of the station have shown that abortion bacilli as a rule seem to multiply nowhere in the bodies of cows but their udders and pregnant uteruses, it may be assumed, if a state of immunity against abortion disease is possible and can be artificially induced, that something may be hoped from intravenous injections of abortion bacilli made some time during the period of gestation, not too early to cause a real disturbance, but early enough for the body of the cow to be influenced by the free multiplication of abortion bacilli in her uterus. As acquired immunity against an in-

fectious disease results from the stimulation of something within the body by the specific germs of the disease, it is not unlikely that past attempts to produce immunity against abortion disease have given contradictory and discouraging results because the injections of so-called immunizing agents were not properly timed.

The milk of a cow which has received an intravenous injection of abortion bacilli, in addition to her placenta, often becomes infected, and abortion bacilli may be discharged through her vagina continuously for 10 days or more after she has given birth to a calf. These are factors which should be kept in mind in all attempts to induce immunity against the disease with injections of live, virulent cultures of abortion germs.

TUBERCULOSIS.

The observations made in the course of the year, like those made at the station for approximately a dozen years, have again emphasized the great value of scrupulous cleanliness as an aid in fighting the spread of tuberculosis among domestic animals.

Tests made with domesticated white and wild gray mice proved that their bodies may harbor enormous numbers of tubercle bacilli months after they have been permitted to eat fresh tuberculous material on only one day. The tuberculous material fed in the tests contained bovine types of tubercle bacilli, and it is not known whether human types would give similar results. The mice not only harbor the bacilli in their bodies but expel them freely through their bowels with their feces in gradually increasing numbers. Microscopic preparations of the lungs of mice made six months after they had eaten the tuberculous material often look like smears from pure cultures of tubercle bacilli. Mice which had eaten tuberculous material on only one day were fed three to five months later to a number of hogs, one hog receiving only a single mouse, another two mice, another three, and another four. All four hogs were found to be affected with tuberculosis approximately three months later, and the disease was either completely generalized or rapidly spreading.

The tests formed a part of a series of investigations undertaken to find an explanation for the recurrence of tuberculosis in originally tuberculous, cleaned herds of cattle. Such recurrence is not uncommon, and is usually attributed to inadequate disinfection of premises or some other cause which can not be accepted as satisfactory in the light of our observations. If the common gray mouse, which is very abundant in our stables, can become a carrier of tubercle bacilli by eating tuberculous material on only a single day, and remain a carrier and disseminator of tubercle bacilli for months, it is urgently necessary in our attempts to disinfect stables which have harbored tuberculous animals to include the extermination of mice. Tubercle bacilli expelled on feed from the bodies of infected mice probably are more dangerous than those which are adherent in masses of dung on the walls of stables or those which have been trampled into the floor.

Rats, as was pointed out in a previous report, may harbor tubercle bacilli in their bodies for long periods of time after having eaten tuberculous tissues on only one day. The bacilli cause no dis-

coverable lesions and are not as numerous as in the bodies of mice, and are not expelled as freely.

During the year 250 samples of cheese obtained on the market were tested for the presence of virulent tubercle bacilli, and 16 samples of fresh varieties were found to be infected, in all cases with bovine types of the germ. Fifteen of the infected samples belonged to one kind of cheese which is of interstate importance, and it is gratifying to be able to report that it was possible to enforce measures which promise to secure its freedom from contamination in the future. The one additional infected sample was a fresh, local product which has no general significance. On the whole the investigation indicates that so far as tubercle bacilli are concerned most kinds of cheese are safe food.

EQUINE VESICULAR STOMATITIS.

The widespread outbreak of equine vesicular stomatitis among horses collected by agents of the French and English Governments for shipment to Europe, and its subsequent spread to cattle, and the remarkable resemblance of the lesions to those of foot-and-mouth disease, necessitated many tests for diagnostic purposes.

The conclusions supported by special investigations at the Experiment Station may be briefly stated as follows: The disease is highly contagious for horses and cattle, less so for the latter than the former; it can be induced in hogs by artificial inoculation but does not result from simple contact exposure; sheep and small experiment animals are entirely immune; the germ has not been discovered but does not seem to belong to the group of organisms which can pass through porcelain filters; an attack of the disease confers immunity against another, but the full duration of such immunity has not been determined; the period of incubation is very short, and the period during which attacked animals disseminate the infection is, in most cases, also very short.

EXPERIMENTS AND DEMONSTRATIONS IN LIVE-STOCK PRODUCTION IN CANE-SUGAR AND COTTON DISTRICTS.

The live-stock production work in the cane-sugar and cotton districts was begun in 1914, and is directed by a committee consisting of William A. Taylor, Chief of the Bureau of Plant Industry, chairman; B. H. Rawl, Chief of the Dairy Division, Bureau of Animal Industry; and W. R. Dodson, director Louisiana experiment station and director of extension service, Louisiana State University.

IBERIA EXPERIMENT FARM.

The Iberia Experiment Farm of 500 acres, at Jeanerette, La., which was presented to the department by the State of Louisiana, is now equipped for carrying on investigational work with horses, mules, beef cattle, dairy cattle, and hogs. Mules and draft mares have been used on the farm and at the same time have furnished a comparison of their relative costs for farm work. Data obtained indicate that a mare must produce a colt to the value of \$103 every two years in order to be as economical as a mule. The cost of raising a mule on

this farm to the age of 2 years was found to average \$102 for a 957-pound mule.

A herd of 40 beef cows is being kept to determine the cost of maintaining a beef-breeding herd, to test the relative merits of fall and spring calving, and to determine the cost of producing a feeder steer or a breeding heifer.

During the winter 60 steers were fed 100 days to compare different kinds of silage as roughage when used with cottonseed meal for fattening. The lot of 10 fed on corn and soy-bean silage made the greatest daily and total gain, with the lots fed respectively on corn silage, sorghum, Japanese cane, whole cane, and cane-top silage following in the order named.

A dairy herd of 13 registered and 16 grade Jersey cows was acquired during the year. Three of the registered cows already have been entered in the Register of Merit with records of production, two are under test, and the remainder will be entered as soon as possible. The completion of the dairy group of buildings makes it possible to begin experiments to determine the cost of producing a gallon of milk and the cost of raising dairy heifers.

In the summer various crops were used for hog grazing. These included sweet corn, field corn, cowpeas, soy beans, and sweet potatoes, some alone and some in combination. The greatest gains were made with field corn and cowpeas.

LIVE-STOCK EXTENSION.

In many sections of Louisiana the growing of cane and cotton has caused live-stock production to make slow progress. In order that stock raising might be extended throughout the State, local demonstrations in the different branches of live-stock husbandry have been conducted, in cooperation with farmers, in the several parishes. By this method it has been possible to show in actual operation the most economical and approved methods of handling, feeding, and managing live stock. During the year 88 demonstrations of that kind were carried on, of which 28 were with beef cattle, 32 with swine, and 28 with poultry. Already there is a noticeable increase in the live stock on farms and great improvement in general methods of live-stock management.

Emphasis has been placed upon the use of winter grazing crops for live stock; the use of legumes, especially velvet and soy beans, planted with corn for finishing cattle and hogs was encouraged; and efforts were made to increase the acreage of the clovers, lespedeza, Bermuda, and the native grasses that are suitable for forage.

Local live-stock demonstrators were advised by the specialist as to the best crops to grow and proper methods for handling them. Every effort was made also to increase the acreage of crops grown for food, in order that this region may do its share in the emergency.

To demonstrate the possibilities and methods of managing a beef-producing herd, 28 local demonstrations were carried on in the different parishes. In these herds beef bulls are being used to grade up native cattle, although there are a few beef females.

Interest in hog raising has increased through Louisiana. Demonstrations in 32 communities have resulted in a greatly enlarged acreage of forage crops for hogs. The better feed used and the greater

attention given to breeding has improved the quality of pork. More attention is now paid to the finishing of hogs for market.

Poultry demonstrations conducted in 28 communities have brought about a marked improvement in the quality of poultry on farms in all parts of the State. In addition to the help given local demonstrators, more than 50 one-day demonstrations were conducted in caponizing, selecting breeding stock, egg candling, and poultry-house construction, and considerable time was devoted to the food-preparedness campaign.

In addition to demonstrations in curing pork and pork products for home use and encouraging the use of local ice plants for preserving meat, cooperative shipping of live stock was begun in 12 parishes, and arrangements were made for shipment in 12 others. Personal assistance was given in grading and shipping 23 carloads of cattle, hogs, and sheep. To facilitate the shipment of live stock to northern markets a special fast-train service has been arranged with two of the railroads. The marketing of live stock has been greatly improved through the reorganization of the New Orleans market and the completion of a packing plant. Assistance was also rendered to woolgrowers in the marketing of 200,000 pounds of wool.

Although there are five creameries in Louisiana, a very large part of the dairy interest is made up of farmers who ship their milk to New Orleans. These dairymen were advised in building silos and barns, and assistance was given in the construction of 17 silos, 8 milk houses, and 13 barns. Among the latter was one erected on the State fairgrounds at Shreveport which will serve as a model and a demonstration. Great interest is manifested by the dairymen in better dairy cattle, with the result that assistance was given in the selection of 256 head of cattle, consisting of 23 pure-bred bulls and 233 good dairy cows. As an indication of the quality of cattle introduced, one Holstein-Friesian bull was purchased at a cost of \$1,750. Herd records were begun and carried on in 20 herds. The records obtained enabled the dairymen to dispose of unprofitable producers and in one instance the income from the dairy was increased \$29 a cow for the year. Besides the direct benefit from the disposal of uneconomical cows, the herd-record work has improved the quality of milk, and little sour milk is now shipped to New Orleans. These herd owners are raising more feed and are pushing tick eradication, and they have less trouble with city dealers on weights and tests.

REPORT OF THE CHIEF OF THE BUREAU OF PLANT INDUSTRY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
Washington, D. C., October 13, 1917.

SIR: I have the honor to submit herewith a report of the work of the Bureau of Plant Industry for the fiscal year ended June 30, 1917.

Respectfully,

WM. A. TAYLOR,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The Bureau of Plant Industry includes in its field a wide range of activities having to do with the solution of plant problems. These relate especially to crop production and utilization, including the improvement of plants by breeding and cultural methods, the investigation and development of methods of control of destructive diseases of plants, the introduction and acclimatization of crops from other parts of the world, the determination of crop relationships, both agronomic and economic, and the meeting of agricultural emergencies as they arise from time to time in widely separated regions of the country.

Throughout the year special attention has been devoted to increasing the staple food and feed crops both through the activities of several of the large divisions of the bureau and also in cooperation with other Federal and State agencies.

The organization during the year has been as follows:

Laboratory of Plant Pathology	Erwin F. Smith, Pathologist in Charge.
Pathological Collections	Flora W. Patterson, Mycologist in Charge.
Fruit-Disease Investigations	M. B. Waite, Pathologist in Charge.
Investigations in Forest Pathology	Haven Metcalf, Pathologist in Charge.
Citrus-Canker Eradication	Directed by Karl F. Kellerman, Associate Chief of Bureau.
Cotton and Truck Disease Investigations	W. A. Orton, Pathologist in Charge.
Crop Physiology and Breeding Investigations	W. T. Swingle, Physiologist in Charge.
Soil-Bacteriology and Plant-Nutrition Investigations	Directed by Karl F. Kellerman, Associate Chief of Bureau.
Soil-Fertility Investigations	Oswald Schreiner, Biochemist in Charge.
Acclimatization and Adaptation of Crop Plants; Cotton Breeding	O. F. Cook, Bionomist in Charge.
Fiber-Plant Investigations	L. H. Dewey, Botanist in Charge.
Drug-Plant and Poisonous-Plant Investigations	W. W. Stockberger, Physiologist in Charge.
Physiological and Fermentation Investigations	R. H. True, Physiologist in Charge.

Agricultural Technology.....	N. A. Cobb, Technologist in Charge.
Biophysical Investigations.....	Lyman J. Briggs, Biophysicist in Charge.
Seed-Testing Laboratories; Enforcement of Seed-Importation Act.....	E. Brown, Botanist in Charge.
Cereal Investigations.....	M. A. Carleton, Cerealist in Charge.
Corn Investigations.....	C. P. Hartley, Physiologist in Charge.
Tobacco Investigations.....	W. W. Garner, Physiologist in Charge.
Paper-Plant Investigations.....	Directed by C. J. Brand, Chief of Office of Markets and Rural Organization.
Alkali and Drought Resistant Plant Investigations.....	T. H. Kearney, Physiologist in Charge.
Sugar-Plant Investigations.....	C. O. Townsend, Pathologist in Charge.
Economic and Systematic Botany.....	Frederick V. Coville, Botanist in Charge.
Dry-Land Agriculture Investigations.....	E. C. Chilcott, Agriculturist in Charge.
Western Irrigation Agriculture.....	C. S. Scofield, Agriculturist in Charge.
Horticultural and Pomological Investigations.....	L. C. Corbett, Horticulturist in Charge.
Arlington Experimental Farm.....	E. C. Butterfield, Assistant Horticulturist in Charge.
Gardens and Grounds.....	E. M. Byrnes, Assistant in Charge.
Foreign Seed and Plant Introduction.....	David Fairchild, Agricultural Explorer in Charge.
Forage-Crop Investigations.....	C. V. Piper, Agrostologist in Charge.
Congressional Seed Distribution.....	R. A. Oakley, Agronomist in Charge.
Demonstrations on Reclamation Projects.....	F. D. Farrell, Agriculturist in Charge.

From September 1, 1916, to August 31, 1917, the changes in the personnel of the bureau were as follows: Resignations, 735; deaths, 7; transfers from bureau, 75; furloughs, 48; terminations of appointments, 575; making a total of 1,440 employees dropped from the rolls during that period. There have been made in the same period 1,515 appointments, increasing the total force of the bureau by 75. On September 1, 1917, the numerical strength of the bureau was as follows: In Washington, 991; outside of Washington, 1,364; of which 398 were engaged in the cooperative work on the eradication and control of citrus canker and 148 in the cooperative work on the eradication and control of white-pine blister rust; total, 2,355. The total number of employees in the bureau on the same date a year ago was 2,280.

The activities of the bureau during the past year are outlined more or less fully in the 30 technical papers appearing in the *Journal of Agricultural Research*, 6 papers in the *Yearbook*, 25 *Office Circulars*, 44 *Department Bulletins*, and 27 *Farmers' Bulletins*. Certain of the more striking results of the investigational work, however, that have become evident during the year are here summarized.

PLANT PATHOLOGICAL INVESTIGATIONS.

COTTON DISEASES.

The control of cotton wilt has been further extended through the wide cultivation of the wilt-resistant variety *Dixie*. Detailed reports from 10 cooperative breeders show that their gains last season due to the increased yield of the *Dixie* over other varieties on wilt-infected land amounted to over \$21,000. Sixty other growers reported a total gain of \$46,000. Several thousand farmers are now growing

this cotton, and the work is being extended to Arkansas and other Northern States. It has been found that the Dixie cotton seed has a higher oil content than other varieties tested. The supply of seed of this variety has been greatly increased but is yet insufficient to meet the demand for it. The new, early, big-bolled, wilt-resistant hybrids continue to show great promise, being earlier than the Dixie, as well as heavier yielders.

POTATO DISEASES.

The potato tuber rots, particularly troublesome in the Western States, have been worked out and found to be due to several fungi producing different types of decay hitherto confused. Remedial measures have been demonstrated to be practicable. In irrigated regions potatoes should not be planted on newly reclaimed land until crops of alfalfa and grain have preceded them. Careful selection of seed, the use of a seed plat, and seed disinfection are advised. Improved methods of seed treatment have been worked out. Careful handling and cool storage have controlled powdery dry-rot. The potato "leak" of California has been controlled in car-lot shipments by sorting out all bruised and wounded tubers.

The continued shortage of potash is affecting the crop in portions of the Atlantic States. The appearance of the plants suffering from potash hunger is so characteristic that the deficient fields may be recognized and the next crop safeguarded by potash fertilizer, stable manure, or compost. .

CUCUMBER DISEASES.

In the investigation of cucumber diseases important discoveries have been made. The so-called "white pickle" has been shown to be a mosaic disease, transmitted chiefly by insects, and its control therefore, if accomplished, will be through the extermination of infected insects. It has also been determined that both the anthracnose and the angular leaf-spot of cucumbers are transmitted in the seed. A special study of the process of seed saving in relation to this factor was carried on last season. Various methods of seed treatment were tested to determine their effect upon germination and their value as disinfectants.

WATERMELON DISEASES.

Further experiments on the control of stem-end rot of watermelons have been very successful. It has been found that losses in transit due to the appearance of this disease can be largely prevented by the application of a disinfectant paste to the cut stems of the watermelons before shipment. Many carloads have been treated in this manner, and the growers in the sections where demonstrations have been made are rapidly putting the method into practice, with great reductions in loss in treated cars as compared with untreated cars. Many buyers are now demanding that melons be treated, and are in some instances paying higher prices for treated lots. Watermelon anthracnose, another serious disease in many sections, has been successfully controlled by spraying with Bordeaux mixture.

ROOT-KNOT OF COTTON AND TRUCK CROPS.

That the root-knot nematode is a larger factor in southern agricultural operations than has heretofore been realized is shown by the results of a survey made during the past year by which the actual amount of loss due to this disease in one county in the cotton belt and two counties in the southern trucking district was determined. The average loss per acre from injury to the cotton crop was estimated at \$3.06. The total loss in this county, which produces on the average 100,000 acres of cotton per annum, was estimated at \$280,000 for last season.

In the trucking district, where 2,113 acres of truck crops were examined, the total loss due to root-knot was found to be over \$160,700, or an average loss per acre of about \$77. Taking these figures as a basis, the total loss in one county was estimated at \$390,000. These results emphasize the economic importance of the root-knot nematode in the South. The disease is widespread, affecting a great variety of crops and constituting a problem that is fundamental to the agricultural prospects of all southern sandy soils. Satisfactory rotations have been worked out for the cotton belt and are being put into practice. A carefully conducted test to determine the value of cyanogen in the control of the root-knot of dasheens showed that its use is not practicable, as its cost when used in the quantity necessary to control the disease is prohibitive. A very successful method of controlling this disease, however, by treatment with hot water has been worked out and thoroughly tested.

DEMONSTRATIONS OF METHODS FOR THE CONTROL OF COTTON AND TRUCK CROP DISEASES.

Particular attention has been given during the past year to the organization of pathological extension work in the various States, in cooperation with the State extension organizations, in order that the methods of control already worked out for many diseases of cotton, truck, and forage crops might be more clearly demonstrated to the growers and put into actual practice in the infected sections. Plans for the undertaking of such demonstrations in the States of Arkansas, Florida, Georgia, New Jersey, South Carolina, Texas, and Vermont have been completed and actual demonstrations started on the control of cotton and sweet-potato diseases in some States. Programs of work have been prepared for the wilt, root-knot, and anthracnose of cotton, for watermelon wilt, anthracnose, and stem-end rot, for asparagus rust, and for sweet-potato diseases. These include provisions for the breeding and propagation of disease-free and disease-resistant seed. Pathological advisers have been appointed for both the northern and southern divisions. These pathologists instruct the county agents in the details of control methods and assist them in carrying out demonstrations in the infected sections.

WHEAT BACTERIOSIS.

A new bacterial disease of wheat has been given very careful study. This disease has been discovered in many States in the Middle West from Texas to Minnesota and Montana, being most prevalent at the present time in Kansas. This disease in favorable years is capable of

doing immense damage, once it is generally disseminated. How long it has been in the country and when and where first introduced are not known. It has attracted considerable attention in Kansas since 1915 and must have been in that State much earlier than 1915. It is quite certain that it has been disseminated from Kansas to other States on seed wheat several times in recent years, both north and south. It is a disease admirably adapted to general dissemination, owing to the fact that the organism after attacking leaves, stems, and heads of the wheat finally lodges on and in the kernels, by way of which it is carried over to the crop of the following season. The kernels of badly attacked heads are shriveled, and such kernels are very likely to be carriers of the organism either on their surface or in their interior. Bacterial cavities in the interior of such wheat grains are very common. The more conspicuous signs of the disease are brown stripes on leaves, or many whole leaves dead in advance of maturity; black stripes on stems, especially the upper parts and often on all sides, so that the stem is nearly girdled in advance of the ripening of the grain; a dark stain on the joints of the rachis; and parallel black lines or stripes on the glumes. The awns are also often black in whole or in part. Frequently there is a yellow bacterial ooze from leaves, stems, and heads, in the latter case both to the surface and inward over the grains.

It is of the utmost importance to know speedily the extent to which this disease has gained a foothold in the United States and to restrict its spread in every possible way.

Further observations and experiments are under way in cooperation with the experiment stations of Wisconsin and Kansas, but enough has been learned to make it certain that the disease is transmitted on the seed. Plump kernels do not contain bacterial cavities, but shriveled ones often do. At the very least, therefore, the latter should be screened out carefully from all wheat designed for seed. Farmers whose fields are now free from this disease should be on their guard against its introduction, since if once introduced it is likely to remain in the soil indefinitely.

SMUT OF CEREALS.

The studies of bunt or stinking smut which were begun recently in cooperation with the State Agricultural Experiment Station at Pullman, Wash., have yielded some important results. They have shown that the solution of the bunt problem in the Pacific Northwest depends, at least largely, upon (1) the general practice of crop rotation, (2) the abandonment of summer fallowing, (3) the general use of smut suction fans on thrashing machines, and (4) consistent and universal seed treatment.

There appears to be a possibility of being able to distinguish in the field the two species of wheat bunt. Observations in Michigan seem to confirm the impression that one of these appears in the field as a "high smut," while the other breaks out lower down and is called a "low smut."

RUSTS OF CEREALS.

Among other data, many facts have been accumulating during the past three years concerning the relation of growth factors to rust

epidemics. In the black stem-rust survey of the principal wheat States, already mentioned, it is found that the barberry is rare in Texas, Louisiana, Oklahoma, Missouri, and Kansas, and that even where it does grow in these States rust is seldom found on it. Outside the spring-wheat area this shrub is of slight economic importance from the standpoint of its probable relation to rust epidemics. Barberry infections, however, are usually abundant in the spring-wheat States. The eradication of the barberry in these States has been recommended, and much has been done in that line.

STRIPE AND BLOTCH DISEASES OF BARLEY.

Extensive seed-treatment experiments conducted in cooperation with the Wisconsin Agricultural Experiment Station at Madison show conclusively that the stripe disease can be almost completely prevented. At the same time, it appears that this disease is fully as destructive to barley in that State as the barley smut. Additional facts have been obtained concerning the relation of climate to the infection of barley by the three fungi causing the stripe, spot-blotch, and net-blotch diseases.

PEAR-BLIGHT UPON PEAR AND APPLE.

The great pear-blight outbreak which began in 1914 has been materially reduced as far as apples in the Eastern States are concerned, but considerable attention has been devoted to service work in the eradication of this disease and to cooperative work in Idaho and Texas in controlling epidemics on apples and pears.

CEDAR RUST UPON APPLE.

The complete success in controlling cedar rust by the eradication of the red cedars has been a marked feature of this work in the large commercial apple districts. Cedar rust still remains a serious disease in many localities, particularly where orchards do not form a dominant part of the plant industry. While there are certain phases of this subject that require further investigation, the main problem may be regarded as definitely settled. Whenever it is desired to control apple cedar rust in an apple-growing community, it can be effectively and permanently accomplished by destroying the red cedars in the winter.

PECAN ROSETTE.

Pecan rosette is regarded by the southern pecan growers as the most serious menace to that industry. The work of this and previous years indicates that the disease is not caused by parasites or other organisms but is a nutrition trouble induced by deficiency in soil moisture and plant food. Experimenting along this line, the disease has been practically eliminated from a large number of trees on the test plats. Results of a striking character have been obtained in the experiments for controlling this disease.

ANTHRACNOSE, OR WITHER-TIP, OF CITRUS.

Experiments in control have been continued on limes in southern Florida, with successful results, these being the first definite results

on that fruit. Inoculation tests have shown a restriction of fruit susceptibility to the early stages of development, and this knowledge has enabled the spraying schedules to be more effectively planned.

CRANBERRY DISEASES.

Special attention has been given to a study of end-rot and its control. This disease has become more prevalent and destructive the past few seasons. It has been found that a parasitic fungus, apparently undescribed, causes this disease, and that it can be largely controlled by thorough spraying with Bordeaux mixture. Investigation of rots and spoilage of this fruit after picking and methods of prevention have been carried on in cooperation with the Massachusetts Agricultural Experiment Station. The results at present show that the loss is partly due to the development of destructive fungi and partly to the rapid death of the fruit, both of which are favored by high temperatures, rough handling, and lack of ventilation. Losses from these causes can be largely prevented by thorough spraying and cooling of fruit as quickly as possible after picking, storing it in a cool, well-ventilated place, and handling it carefully to avoid bruising.

PEACH BROWN-ROT AND SCAB.

During the past two years and particularly in the spring of 1917 in Georgia, dusting experiments with finely divided sulphur were carried on, showing that the dusting method is successful in the control of peach scab and at least promising as a remedy for brown-rot.

SCALD OF APPLES.

It has been found that scald of apples increases with a rise in storage temperature and that it can be almost entirely prevented by good aeration.

DECIDUOUS FRUIT ROT INVESTIGATIONS.

It has been found that most of the rots can make but very slow development at a lower temperature unless they have already started at higher ones. It has also been found that it is practically impossible for the germ tubes of fungous spores to penetrate the sound apple skin. This fact shows the great importance of extreme care in the handling of fruit.

CITRUS CANCER.

With special reference to the citrus industry, it should be noted that the campaign for the eradication of citrus canker, in cooperation with the States of Florida, Texas, Louisiana, Mississippi, Alabama, Georgia, and South Carolina, is progressing very favorably. Recent reports indicate that the disease is under satisfactory control in South Carolina, Georgia, Alabama, and Florida, and its complete eradication throughout that area is perhaps to be expected during the coming year. A somewhat longer time will probably be required for the completion of the work in the remaining States, although in these States also the progress of the work is encouraging.

WHITE-PINE BLISTER RUST.

Field studies of the white-pine blister rust indicate that, as might be expected, the disease is more virulent in America than in Europe and is taking on some new characters.

A systematic survey, tracing nursery shipments of suspected white pine and currants and gooseberries, has been conducted in all States of the Union except Mississippi, Alabama, and Florida. Hundreds of shipments from diseased nurseries or from dangerous localities have been located; these will require annual inspection. Diseased stock has been located at one place in Arizona, one in Iowa, one in South Dakota, one in Michigan, three in Wisconsin, one in Ohio, three in Pennsylvania, and seven in New Jersey. All of this material has been destroyed.

Natural infections of blister rust have been found on the woody stems of wild gooseberry, and similar infections have been produced by inoculation. These results establish an overwhelming presumption that the blister rust can be carried on the wood of cultivated gooseberries and other members of the genus *Ribes* in nursery shipments. They also go far to confirm the suspicion that the disease occasionally overwinters on these plants.

A method of diagnosing dubious or undeveloped cases of the white-pine blister rust from the characters of the mycelium in the bark has been devised.

PLANT PHYSIOLOGICAL INVESTIGATIONS.

PHYSIOLOGY OF "TOBACCO-SICK" SOILS.

In the Connecticut Valley the leading feature of the work has been a study of "tobacco-sick" soils, which are causing heavy losses to growers, particularly under the artificial shades used for growing wrapper leaf. Selected strains of Cuban and of binder types grown on these soils have given very encouraging results, indicating that the disease may be controlled by the growing of resistant varieties. It has also been shown that the use of fertilizers of acid reaction will materially reduce the injury caused by the disease. Finally, crop rotation, wherever practicable, appears to be an effective remedy. A similar or identical disease is giving much trouble in Maryland; and while native varieties are susceptible, these have been crossed with foreign resistant varieties, with a view to obtaining resistant types adapted to local requirements.

In Wisconsin and in the Burley section of Kentucky considerable progress has been made in the control of tobacco root-rot through the development of resistant varieties. The disease causes heavy damage in these regions every year and ordinary Burley is especially susceptible. On fields on which the native Burleys have failed completely, some of the resistant strains have given surprisingly good results.

INCREASING THE PRODUCTION OF DATE OFFSHOOTS.

During the past year important investigations have been under way in connection with the life-history study of the date palm. The

object of these investigations is to determine as accurately as possible the minimum, optimum, and maximum heat and moisture requirements of the date palm, in the hope of discovering the causes of offshoot production. The date industry is now an assured commercial success, but the rapidity of its future extension as an industry in the Southwest depends largely on the discovery of means for the rapid propagation of offshoots. The results already obtained have shown beyond a doubt that a considerable degree of humidity in the air about the plants is necessary, and some success has been obtained in forcing the growth of offshoots on date palms by inclosing the trees in canvas sheds, thus increasing the humidity of the air in immediate contact with them.

INJURY TO PLANTS BY LOW TEMPERATURES.

A laboratory study of the process known to gardeners as "hardening off" plants by exposing them to low but noninjurious temperatures has shown that as the plant becomes increasingly resistant to cold the cell sap becomes more concentrated. When temperatures are carried low enough to produce injury, a change of reaction in the plant juices takes place and proteins are probably precipitated. If the change in reaction does not go too far, the cell recovers, but not otherwise. The biochemical processes involved in these changes are being further investigated. Resistance to injury from frost is found to vary in cabbages with different individuals, and the selection of cold-resistant strains seems likely to be practicable.

PLANT-BREEDING INVESTIGATIONS.

OIL CONTENT OF SEEDS.

Studies on the relative oil content of the seed of standard cotton varieties have shown that strains may be developed which, in addition to being resistant to certain diseases and possessing other desirable characteristics, are capable of yielding larger quantities of oil from the seed.

CANKER-RESISTANT CITRUS FRUITS.

In connection with the campaign for the eradication of citrus canker in the Gulf States and Florida, it has been found to be of the utmost importance to secure canker-resistant citrus fruits suitable for culture in this region—especially in the region from Alabama westward to Texas. The Satsuma orange, now largely grown in that section, is fairly resistant to canker, but, unfortunately, almost all other kinds of citrus fruits grown there are highly susceptible to canker. It is very necessary, therefore, to substitute canker-resistant varieties of oranges, grapefruit, lemons, and limes for the varieties now grown, and of even more importance to find canker-resistant stocks to substitute for the trifoliate orange for use in nurseries throughout this region. The trifoliate orange is very susceptible to citrus canker and constitutes a menace not only in the nurseries, where thousands of seedlings are grown in close contact and are therefore liable to epidemic outbreaks of the disease, but also in com-

mercial orchards, where sprouts from the trifoliate orange root are likely to become infected with canker, which in turn infects the surrounding trees.

In view of the difficulty in determining the canker resistance of citrus hybrids in this country, a testing station has been established in cooperation with the agricultural college of the Philippine Islands at Los Banos, on the island of Luzon. At this station, in a climate somewhat similar to that of Florida and the Gulf coast during the rainy season, it is possible to determine within a few months the relative canker resistance of any of the hybrids under test. Evidence has already been secured that there is a great variation in the canker resistance of hybrid citrus fruits, and there is every reason to look forward to the successful outcome of the breeding experiments now under way.

GRAPES.

Hybridization with other types of grapes, pollen of which was sent to the Muscadine-grape experiment vineyard from the Department's experiment vineyards in other parts of the United States, yielded the most successful results so far obtained, and from the seed secured an exceedingly valuable collection of hybrid seedling grapes has been propagated. A collection of the hybrid seedlings propagated during the previous year was planted in the experiment vineyard. From those seedlings in the breeding block of the experiment vineyard which have been developed to the point of bearing fruit, important results from breeding work have been obtained. Among the seedlings coming into fruit during the year there are many of the new hermaphroditic progeny which are self-fertile and of higher quality than the first hermaphrodites produced. The multiplication of this new and most valuable type of grape and its improvement are the most important results from breeding work during the year. A new hermaphrodite seedling of parentage distinct from those previously produced has been secured and is already being used for breeding purposes.

Until the past season, work with Muscadine grapes has been primarily with problems relating to production and breeding. During the past year the investigations previously begun in the utilization of Muscadine grapes, which covered only the making of sirup from the juice, were broadened with a view to working out other practicable methods of utilizing the fruit. These activities have included a study of methods of preparing sirup, grape juice, jelly, canned grapes, spiced grapes, catsup, conserves, preserves, marmalade, jam, and a number of other products.

The results are important, not only because they have set forth methods of preparing very palatable products but from an economic standpoint their special value rests in the fact that heretofore the different ways of using Muscadine grapes have been very limited; these results therefore mean a very much broadened scope of utility for this type of grape.

BUD SELECTION OF CITRUS FRUITS.

The work carried on in California in the improvement of citrus fruits through bud selection has made marked progress during the

year, not so much because of the new facts that have been developed as because of the extent to which the results of the work thus far accomplished have been accepted by the citrus industry and used in the management of the groves. While the year's work has resulted in the accumulation of much additional corroborative information, the feature which stands out most prominently is the evidence that has developed during the past year that the progeny of the trees selected as parent trees from which to propagate are showing a remarkably high degree of consistency in their fruit-producing characteristics. Quite a number of the earlier trees propagated from selected parent trees have now come into bearing. With practically no exceptions, these trees are showing great precocity in bearing and a high degree of uniformity in the character, quality, and quantity of the fruit. In further confirmation of the work, there is evidence also from trees that were propagated from nonproductive trees. The progeny from such parent trees, so far as they have come into bearing, are showing the nonbearing habits of the parent trees from which they were propagated.

The most striking example of the way in which the citrus industry is taking advantage of the results secured in this work, and the confidence that is placed in it, has developed during the year. The California Fruit Growers' Exchange, a cooperative organization of 8,000 members and representing a large proportion of the citrus industry in California, has established an office of bud selection, placing a man in charge of this work.

The aim of the exchange in this work is to aid the growers in securing bud wood from carefully selected trees for use in working over their nonproductive and otherwise undesirable trees. So great is the importance placed by the exchange upon this work that it is serving not only its own members but the independent growers in the securing of suitably selected buds; moreover, the demand for nursery trees propagated from carefully selected buds has become so great that the nurserymen who have propagated their stock according to the old practice of selecting buds are having very material difficulty in selling their trees. In this way practically all of the citrus nurseries are being forced into the propagation of their nursery stock from suitably selected parent trees.

While relatively little progress has been made in the bud-selection work with deciduous fruits, such evidence as has been accumulated during the year tends to confirm the belief that the principles which appear to underlie the improvement of citrus fruits through bud selection are also applicable to deciduous fruits.

POTATO BREEDING.

The work with Irish potatoes has produced about 27,000 seedlings, many of which are yet under test. Studies of seed selection, cultural methods, and varieties to determine their regional adaptability, relative value, and merit for different uses, and certain cooking tests from the variety standpoint are also included in the potato investigations.

HEMP IMPROVEMENT.

Growers of hemp and flax state that the most efficient aid this Department can give to these industries is in securing adequate sup-

plies of good seed. The crop of hempseed last fall, estimated at about 45,000 bushels, is the largest produced in the United States since 1859. A very large proportion of it was from improved strains developed by this bureau in the hempseed selection plats at Arlington and Yarrow Farms. Small packets of this seed have been sent each spring during the last four years to hempseed growers in Kentucky, and 1 pound, grown under favorable conditions, may yield enough seed to sow 20 acres broadcast for fiber. The superiority of these strains is recognized, and they are used for planting nearly all fields of seed hemp.

EGYPTIAN COTTON IN ARIZONA.

The very high prices obtained for the 1916 crop of Arizona Egyptian cotton resulted in the planting of nearly 40,000 acres in 1917, of which 7,000 acres were of the new Pima variety and the remainder of the older Yuma variety. The strength of the demand for this type of cotton is indicated by the fact that a single corporation manufacturing automobile tires has stated its annual requirement for this type of cotton to be 65,000 bales, which it is endeavoring to meet by stimulating production in Arizona.

The efforts of this bureau, cooperating with the growers' associations, to maintain the purity and uniformity of the Pima variety are proving highly successful, as was shown by the very small percentage of plants removed in roguing the fields selected for seed increase.

CHESTNUTS.

Some very promising varieties of chestnuts have been developed, which show considerable promise as nut-producing trees because of their fruitfulness and precocity of bearing as well as their evident measure of resistance to the chestnut bark disease. In this collection of trees there are about 1,500 representing both native and Asiatic varieties, about 50 per cent of which are hybrids. Observations on the hybrid chinkapins which were developed some years ago have been continued. The results are considered especially promising.

AGRONOMIC AND HORTICULTURAL INVESTIGATIONS.

METHODS OF GROWING COTTON UNDER IRRIGATION.

The cultural problems encountered in growing cotton under irrigation are numerous. Means of securing a good stand, methods of spacing, and the manner of irrigating the crop are some of the features that are being studied. The new single-stalk system of culture has contributed to the establishment of the Egyptian cotton industry in the Salt River, Gila, and Yuma Valleys of Arizona and can be used effectively in the production of all cotton under irrigation. The new system not only induces earlier fruiting and tends to insure larger crops but greatly facilitates the picking of the cotton.

The single-stalk system of controlling the branching habits of the cotton plants has made possible, also, another special method of

culture for irrigated districts. The rows are planted in pairs, one on each side of a large furrow. Irrigation is confined to the furrows, which are separated by broader ridges that remain as a permanent mulch of dry soil. The water is applied more effectively, germination and growth of the young plants are more uniform, and less labor is required for cultivation and the control of weeds. The plants soon shade the furrow, but the broader space above the ridges is kept open throughout the season, with the vegetative branches suppressed under the single-stalk system. If the plants grow very large they lean away from the furrow over the dry ground. This, without interrupting the harvest or damaging the ripe bolls; hence larger crops of good fiber can be matured.

COTTON CULTURE IN THE ARID REGIONS.

The dry weather that has obtained during the last three years in the western part of the cotton belt has made plain the desirability of improving the usual methods of culture so as to reduce the losses entailed when the growing season is shortened by drought. It has already been demonstrated that the new single-stalk system of culture is efficacious in this regard, and it seems that still further progress can be made. With a view to determining what greater improvement is possible, a series of experiments has been conducted to study the importance of the time of planting cotton and the relative effectiveness of different distances between the rows, and to make further observations on the time and manner of thinning.

DECIDUOUS-TREE FRUITS.

Attention has been directed to the growing of figs in the South Atlantic and Gulf Coast States, as was the case in 1916. There is apparently a widespread interest in the culture of figs in the regions stated; much of this interest, however, is the result apparently of the activities of fig promotion companies in the developing of large fig orchards. There is, however, an apparent growing appreciation of the fig in the South Atlantic and Gulf Coast States along conservative lines of development. The cultural development and requirements of the fig in this territory have been studied as completely as conditions permit.

SMALL FRUITS.

There has been a material increase in the demand for information on the growing of small fruits. The demand is evidently the outgrowth of natural conditions and a fuller appreciation by the people of this type of fruit. Field studies of the small-fruit industry were carried during the past year to the point where it is possible to prepare an important and much-needed series of bulletins on practically all of the widely grown small fruits. This series of bulletins will treat of raspberries, strawberries in different sections of the country, everbearing strawberries, currants, gooseberries, and, in due course, several others.

PECAN NUTS.

As in previous years the larger activities in connection with the nut-culture investigations have been with pecans. Because of the increased interest in the growing of this nut, it has become increasingly important to determine, as accurately as possible, the geographical range of the species from the standpoint of its culture. Evidence has been secured which tends to confirm a previously expressed conviction that the fruiting of the pecan is uncertain north of the thirty-ninth degree of latitude. While individual trees may be found growing considerably north of this latitude and occasional crops are produced, the uncertainty of bearing appears to be too great to warrant the planting of them for nut production farther north than the latitude specified.

In the study of pecan varieties from the standpoint of their adaptability they may be said now to constitute three groups—Southern, "West Texas," and what may be termed "Indiana" groups. With further studies of varieties from Tennessee and Arkansas, another group may be added to the above.

Individual tree records, with a view to securing accurate data on yields, were continued with the crop of 1916. There is a growing conviction that there are cultural problems with the pecan which are not fully understood. This is apparent in the fact that certain varieties at least usually shed a large portion of the crop that sets, the dropping occurring early in the summer. As nearly as conditions can be correlated, this appears to be connected with the soil-moisture conditions. In much of the pecan-growing territory a rather severe drought usually occurs during the early part of the summer, and it is during this period that much of the trouble occurs.

CORN VARIETIES.

Some investigations have been centered on the requirements of the corn crop from the standpoint of soil temperature. Last year's tests confirm previous results in showing that varieties of too small size are often chosen and that the earlier planting of larger varieties will usually result in better yields and profits. By very early seed-bed preparation and frequent early cultivation larger and more productive varieties can be profitably substituted for very small early maturing varieties.

WHEAT IN ROTATION.

The results of cooperative work in Georgia to the present time indicate that better yields are obtained when wheat follows cotton than after corn. This is a fortunate condition in the southern part of the cotton belt, because of the fact that velvet beans are sown with the corn and the combination is best utilized as pasture. Also good farm practice under boll-weevil conditions makes it necessary to plow under the cotton stalks as soon as the cotton is picked, thus making wheat a desirable crop to follow cotton.

DRY FARMING.

Work is now being conducted at 24 field stations on the Great Plains. At the end of 1916 five of these had completed a continuous

record of ten or more years and 11 others had continuous records of five or more years. Over 4,000 permanent plats devoted to crop rotations and studies of cultural methods are now coming of record each year. Records of such extent and continuity furnish better evidence concerning many fundamental agricultural problems than has ever before been available and enable us to speak with ever-increasing assurance on the questions of adaptation of crops, the response of crops to cultural methods, and the agricultural value and possibilities of each section represented by these stations.

Use is being made of this information to assist the Geological Survey in classifying lands, as required by recent homestead laws. It is also of timely value in directing useful efforts and in checking unsound schemes for the increase of food supplies to meet the present emergency.

The horticultural and plant-breeding work at the Northern Great Plains Field Station, Mandan, N. Dak., has continued to develop. Much new material was assembled for test and propagation and a vigorous test of winter hardiness obtained by the unusually severe winter.

In the spring of 1916, 591,332 trees and cuttings were shipped to 639 accepted cooperators under the project for cooperative shelter-belt development in the northern Great Plains. An average of 80 per cent of this stock grew. In the spring of 1917, 357,700 trees and cuttings were shipped to 639 accepted cooperators; 256 of this number were new cooperators. The other 383 received either additions to or replacements for their 1916 plantings. Four hundred and thirty applications for plantings in 1918 were on file at the time of closing such applications on May 15. This brings the total of possible co-operators for 1918 to 1,257. As not all applicants meet the requirements of the Department, the actual number will probably be between 1,000 and 1,100.

STUDIES OF NEW CROP PLANTS AND CROP EXTENSION.

ESTABLISHING SUPPLIES OF PURE COTTON SEED.

Constructive steps have been taken to establish supplies of pure seed of the superior varieties of cotton that have been developed by this bureau. For a number of years special care has been exercised to inspect all the fields from which seed for the congressional distribution has been obtained, and only seed of known origin and high quality has been distributed. Through effective cooperation with the more interested and appreciative farmers who have received this seed it has been possible to maintain the purity of the stocks and greatly increase the supplies of seed of the superior varieties sent out. In certain sections where community action could be enlisted even greater progress has been made, as it has been possible to devote larger acreages to the production of pure seed. The problem of distributing this seed to the best advantage and of maintaining the purity of the stock is being solved through organization of the seed growers.

ECONOMIC METHODS OF INCREASING SELECTED COTTON SEED.

With a view of avoiding the loss usually experienced by cotton breeders in increasing selected cotton seed, more economic methods

of planting have been devised. The methods ordinarily employed are wasteful in that many more seeds must be planted in order to get a stand than are necessary to produce the number of plants that will be left to mature. The only value of a large part of the seed planted is to produce nurse plants. It is frequently necessary to destroy 50 to 75 per cent of the seedlings in reducing to a stand. By substituting beans or peas for the cotton seed that produce these surplus plants, a large waste can be avoided and two or three years' time gained in increasing the selected stocks to commercial quantities. This method of nurse planting and the means to be employed to make it most effective are described in a report that is being prepared for publication.

A POSSIBLE SUBSTITUTE FOR SEA ISLAND COTTON IN GEORGIA AND FLORIDA.

The production of Sea Island cotton in Georgia and Florida under boll-weevil conditions seems precarious because of the slow-fruited habit of the species. A variety of Upland cotton, called Meade, with the more rapid and prolific fruited habit of Upland cotton, has been developed. This has lint scarcely distinguishable in texture and length of fiber from that produced by the Sea Island cotton of Georgia and Florida. The yield from plantings of the Meade variety this season in southern Georgia in comparison with that from Sea Island cotton indicates that the former may be a successful substitute for the latter in that section.

EXTENSION OF COTTON FARMING IN THE SOUTHWEST.

Under the stimulus of continued high prices, cotton farming is extending rapidly in many of the irrigated valleys of the Southwestern States beyond the supposed limits of the cotton belt, where the possibility of developing a new cotton industry has been clearly demonstrated in recent years by the work of this bureau. The acreage devoted to Egyptian cotton in the Salt River Valley of Arizona is now approximately 35,000 acres, as compared with 3,500 acres in 1913. In the Imperial Valley of California, where in 1909 there were only 450 acres of cotton, there are now 75,000 acres, of which nearly half is Durango, a long-staple Upland variety from Mexico, acclimatized by this bureau. The remainder of the cotton grown in this valley is of the short-staple type. In 1911 there were only 30 acres of cotton in the Yuma Valley of Arizona and California, while now there are 12,000 acres, one-third of which is devoted to the production of the Egyptian type and two-thirds to short staple. Commercial quantities of cotton are reported also from the Pecos Valley of Texas and New Mexico, the upper San Joaquin and upper Colorado River Valleys of California, the Pahrump Valley of Nevada, and the Virgin Valley of Utah, Arizona, and Nevada.

The agricultural and commercial problems of this new industry in the Southwestern States are being solved through growers' cooperative organizations. It has been found that the dry climate affords a protection against invasion by the boll weevil and allows the cotton, which is of high quality, to be harvested in a condition that commands special prices in the market. These advantages

compensate for the higher cost of labor and transportation. But in order to maintain the superior quality of the fiber, skillful farming is necessary, and special precautions must be taken to preserve the purity and uniformity of the varieties.

FOOD VALUE OF THE DATE.

At the present time the commercial culture of dates in this country is limited to the growing of the choicest varieties only, such as the famous Deglet Noor, and the product is of so high a quality that it is sold along with confectionery at prices exceeding that paid for any other dried fruit. This bureau's experiments have shown, however, that other varieties can be grown successfully and put on the market at a very low unit price, providing the packing, transportation, and marketing are properly systematized. In particular, the so-called "dry dates" of the Arabs, which in the date-growing countries of the Old World largely take the place of bread, are capable of being grown and marketed with profit in this country at a very low price. The better varieties of dry dates are of surprisingly good quality and keep very well, besides having the great advantage of being much easier to pick and pack than ordinary dates and requiring no curing whatever.

CONGRESSIONAL SEED DISTRIBUTION.

During the fiscal year 1917 there were distributed on congressional and miscellaneous requests 12,170,448 packages of vegetable seed and 3,812,467 packages of flower seed, or a total of 15,982,915 packages, each containing five packets of different kinds of seed. There were also distributed 12,735 packages of lawn-grass seed, 650 packets of tobacco seed, and 11,159 boxes of imported narcissus and tulip bulbs. The seeds and bulbs were purchased on competitive bids, as heretofore. Each lot of seed was thoroughly tested for purity and viability before acceptance by the Department, and tests of each lot of seed were conducted on the Department's trial grounds to determine trueness to type. Approximately 35 per cent of the seed was secured from "surplus" stocks, the remainder being grown for the Department under contract.

NEW AND RARE FIELD-SEED DISTRIBUTION.

A distribution of new and rare field seeds was made throughout the entire United States, having for its object the dissemination of seed of new and rare field crops, seed of improved strains of staple crops, and high-grade seed of crops new to sections where the data of the Department indicate such crops to be of considerable promise. Each package contained a sufficient quantity of seed for a satisfactory field trial, and the recipient was urged to use the seed, if feasible, for the production of stocks for future plantings. A report card and a circular giving full directions for the culture of the crop accompanied each package of seed.

Only seed of new crops or of improved strains of standard crops was distributed, including the following: Grimm, Baltic, Peruvian,

Kansas-grown and Dakota-grown alfalfas; yellow and white sweet clover; Brabham, Groit, and Early Buff varieties of cowpeas; fet-erita; Kaiser, Bangalia, Carleton, French June, Golden Vine, and Chang varieties of field peas; Natal grass and Rhodes grass; Dwarf hegar; Dwarf Blackhull kafir; Kursk millet; white milo; Red Amber, Orange, Honey, and Freed sorghums; Black Eyebrow, Haber-landt, Mammoth Yellow, Manchu, Tokio, Early Green, Ebony, Hollybrook, Ito San, Peking, Virginia, and Wilson cowpeas; five varieties of soy beans; Sudan grass; Georgia and Yokohama varieties of velvet beans; Acala, Columbia, Dixie, Durango, Holden, Lone Star, and Trice varieties of cotton.

During the year 244,463 packages of new and rare field seeds were distributed, including 90,067 packages of cotton seed. The results obtained were gratifying and indicated the value of a distribution of this kind. Such a distribution enables a farmer to secure seed of new and improved crops in sufficient quantities to produce stocks for future seeding, the general effect of which is gradually to improve the crops of the country.

FLOOD-RELIEF SEED DISTRIBUTION.

On August 3, 1916, Public Resolution No. 28, Sixty-fourth Congress (S. J. Res. 160) was approved, appropriating \$540,000 for the relief of flood sufferers in the States of North Carolina, South Carolina, Georgia, Alabama, Florida, Tennessee, and Mississippi, out of which appropriation \$80,000 was set aside by the War Department for use by the Department of Agriculture in purchasing and distributing seeds to provide food for the population and feed for the animals of the flood areas. Through cooperation with the Office of Extension Work in the South of the States Relations Service, the State and district leaders and county agents furnished information regarding the number of destitute families in the flood areas needing seed and handled the direct distribution of the seed furnished by the Department.

During the autumn of 1916, 1,035,514 pounds of field seeds and 24,934 pounds of vegetable seeds were distributed, the field seeds including buckwheat, cowpeas, Italian rye-grass, millet, oats, pasture-grass mixture, rape, sorghums, soy beans, and Sudan grass, and the vegetable seeds including turnip, kale, spinach, beet, and collards.

During the spring of 1917, 5,150 bushels of corn, 3,550 bushels of soy beans, 1,700 bushels of cowpeas, 2,525 bushels of velvet beans, and 5,000 collections of vegetable seeds were distributed to destitute farmers in the flood areas. Approximately 21,000 destitute families were reached by the flood-relief seed distribution, and the numerous reports of the Department's agents show that the distribution of this seed to the destitute farmers in the flood areas was timely and effective.

VELVET BEANS.

The increased culture of the velvet bean in the South during the past two years has been one of the most remarkable recent developments in our agriculture. Heretofore the culture of the velvet bean has been largely limited to Florida; but with the introduction by the Department of several early varieties (particularly the Chinese)

and the development of other varieties by breeding (especially the Georgia and the Osceola), the culture of the velvet bean has been extended to cover a large part of the cotton belt, especially on the more sandy soils. It is estimated that the acreage planted to velvet beans in 1916 was at least fourfold that of any previous year, and it is not improbable that the acreage of 1917 is at least four times that of 1916.

SOY BEANS.

While the soy bean is still one of the minor field crops, the acreage has increased greatly in the last three years, primarily because it was found profitable to utilize the beans in large quantities for the production of oil and cake. Inasmuch as soy beans can be raised in the United States at approximately the same cost as in Manchuria, there is reason to believe that this industry will reach very large proportions. The soy bean has also gained considerable popularity in the United States as a human food. Large quantities of the mature beans have been used by canners in preparing pork and beans and similar products. The green beans have also been canned and have met with a ready sale.

RHODES GRASS.

Rhodes grass has rapidly grown in popularity both in Florida and southern Texas. In the latter State very large areas of land, both irrigated and nonirrigated, have been planted to this grass. Both for hay and for pasturage it has proved far superior in southern Texas to any other plant.

SUGAR-BEET SEED PRODUCTION.

Previous to the war practically no sugar-beet seed was produced commercially in this country. This bureau, in cooperation with the beet-sugar and beet-seed companies, has succeeded in building up the commercial production of sugar-beet seed until it amounts to about 25 per cent of the annual planting requirements of the sugar-beet growers. This industry is rapidly increasing, and the indications are that the production of sugar-beet seed will be nearly doubled next year. One new beet-seed company has just been formed, and a member of the office force of this bureau has been employed as general manager.

BARLEY AND OTHER GRAINS.

On account of its higher yield of feed per acre, barley is being urged as a substitute for oats in sections of the Northern and Western States. In all grains the use of new high-yielding varieties is being rapidly extended. Three new varieties of oats, two of barley, one of rye, and one of rice were grown on considerable acreages in various States this year.

BINDER-TWINE FIBER.

The marked increase in the cost of binder twine, due to the increased cost of henequen (Yucatan sisal), in common with all other

fibers, has aroused a demand for greater supplies of fiber suitable for binder twine.

Work has been started in the development of improved strains of henequen (*Agave fourcroydes*) and sisal (*Agave sisalana*) in cooperation with the Porto Rico Experiment Station at Mayaguez.

Work is being started in cooperation with the Philippine Bureau of Agriculture in Manila to encourage an increased production in the Philippines of fiber suitable for binder twine. The production of Manila maguey, a fiber similar to henequen but somewhat inferior, has increased from 59,940 bales in 1915 to 129,263 bales in 1916. All of this has been cleaned by hand after soaking the leaves in water, a process that injures the fiber.

Fiber-cleaning machines are being introduced into the Philippines to demonstrate the production of fiber better than maguey.

The increasing production of henequen in Cuba and of Manila maguey in the Philippines and the reports of sisal plantations in many places indicate that the increasing demands for fiber of this class will be met by production outside of Yucatan.

AGRICULTURAL INDUSTRIES ON RECLAMATION PROJECTS.

To encourage and aid in the development of agriculture on the Government reclamation projects, work is directed toward the promotion of specific agricultural industries for which the conditions on the several projects are favorable. The agricultural problems confronting the settlers on these projects form two classes: (1) Problems of crop production; (2) problems of crop disposal or utilization. Of the two, the problems of crop disposal or utilization are generally the more acute. The isolated locations of these irrigated areas make it impracticable to ship to the consuming centers the bulk of the farm crops produced, particularly in view of the fact that approximately 80 per cent of the cropped area of these projects is devoted to the production of forage and grain crops. Profitable utilization of these crops necessitates the establishment of live-stock industries. The improvement and maintenance of the productivity of the soil also require that live stock be fed upon the farms, so that the manure can be applied to the land. In view of these facts, the major portion of the work of the office mentioned is being directed toward the establishment of live-stock industries.

On a few of the projects there are acute problems of crop production affecting all crops. On a large number of the projects serious production problems are encountered only in connection with crops which are desired to supplement other crops which are produced abundantly. Part of the activities of this office are directed toward the production of such supplementary crops.

During the fiscal year 1917 the work of demonstrations on reclamation projects was in progress on nine projects, as follows: North Platte, Nebraska-Wyoming; Truckee-Carson, Nevada; Huntley, Montana; Minidoka, Idaho; Tieton, Washington; Shoshone, Wyoming; Boise, Idaho-Oregon; Umatilla, Oregon; and Uncompahgre, Colorado.

The marked economic readjustments made necessary by international conditions have resulted in considerable instability in the

agriculture of the reclamation projects. It has been necessary to make various minor modifications in the plans of work. In spite of the instability of agricultural conditions on the reclamation projects and in the country generally, substantial progress was made during the year in the work in promoting agricultural industries.

DAIRYING.

During the year demonstration work in dairying has been conducted on the Truckee-Carson, Huntley, Minidoka, Tieton, Shoshone, Boise, North Platte, and Uncompahgre projects. In this work the settlers have been assisted in securing stock, improving local dairy herds through breeding and cow testing, controlling diseases, planning and constructing barns and silos, and in improving their methods of feeding and marketing. During the year improved methods of financing the purchase of breeding stock were inaugurated on several of the projects. One cow-testing association was established on the Truckee-Carson project and another on the Tieton project. In addition to this association testing work, systematic cow-testing work in 71 individual herds was carried on. A bull association was organized on the Tieton project. Three bull clubs were organized. New cheese factories were placed in operation on the Boise, Uncompahgre, Minidoka, and Tieton projects. The operation of these cheese factories has done much to improve the marketing conditions affecting dairy projects. As a means of securing a better utilization of the locality-grown feeds, much attention has been paid to the building of silos by dairy farmers. During the year assistance was given in the construction of 42 silos, and the educational work done in this connection has resulted in greatly increased interest in the subject. Speaking generally, the dairy industry on the reclamation projects has experienced marked improvement during the year, particularly with reference to increased community interest and cooperation.

THE SWINE INDUSTRY.

Work in connection with the establishment of the swine industry is in progress on the North Platte, Truckee-Carson, Huntley, Minidoka, Tieton, Shoshone, Boise, and Uncompahgre projects. The settlers on these projects have been aided in solving the problems of breeding, feeding, housing, and marketing their hogs, and in the control of diseases, particularly hog cholera. The unusually high prices for feed and for pork resulted in a marked reduction in the swine population on most of the projects where we are operating, but the decline in the swine population resulted chiefly from reductions in the sizes of individual herds. There is a marked tendency to grow swine in smaller herds than was formerly the case, and this tendency is being encouraged, as it makes for a better utilization of waste materials and hence a lower cost of production. Special attention was paid during the year to better feeding, with particular reference to better methods of utilizing locally grown feeds. As a part of this work 53 practical farm feeding tests were conducted on the North Platte, Boise, Uncompahgre, Tieton, Shoshone, Huntley,

and Truckee-Carson projects. These 53 tests included 2,161 head of swine, and the results stimulated interest in better methods of utilizing alfalfa pasture, corn, field peas, and other farm crops used in swine production. Substantial progress was made in the cooperative marketing of swine, particularly on the Truckee-Carson, North Platte, Huntley, and Uncompahgre projects. The swine diseases which appeared on the projects were effectively controlled. Hog cholera appeared on several projects, but was epidemic on the North Platte project only. On this project there were 70 outbreaks, and preventive treatment was applied in 88 herds, including 5,910 hogs, of which 87 per cent were saved. There are on the projects where we were operating about 30 organizations of swine growers, which are doing effective work in the control of swine diseases. Attention was paid to the control of minor diseases and pests affecting swine, and satisfactory results were secured from these activities.

THE BEEF INDUSTRY.

The beef industry has received attention chiefly on the Minidoka, Tieton, Boise, Shoshone, and Uncompahgre projects. The settlers on these projects have been assisted in securing improved breeding stock and in improving their methods of feeding. Special attention has been paid to the organization and conduct of farmers' associations for cooperative use of range lands adjacent to the projects. This cooperative grazing is now being practiced by settlers on the Boise, Minidoka, Shoshone, and Tieton projects. Considerable attention was paid to the control of blackleg among beef cattle. Preventive treatment was administered to 4,481 head of stock and the method of immunization was explained to the farmers. Cooperative marketing of beef stock was successfully inaugurated on the Shoshone project.

SHEEP PRODUCTION.

During the past year there has been more interest in sheep production than in any other live-stock industry, as the result of the unusually strong demand and high prices for mutton and wool. The chief work in connection with sheep production was done on the Minidoka, Truckee-Carson, Shoshone, Boise, Uncompahgre, and Huntley projects. Special attention has been paid to securing breeding stock for the settlers. This has usually been possible by keeping in touch with the range sheep producers and by disseminating among the settlers information as to where breeding stock could be secured. Attention has been paid to methods of feeding, particularly on the Minidoka project. A Department Bulletin, No. 573, entitled "The Sheep Industry on the Minidoka Reclamation Project," was prepared during the year. This bulletin describes the sheep industry on the Minidoka project, where it has reached a high degree of development, and discusses the conditions under which the industry is being built up. The material in this bulletin has been made available to the settlers on the other reclamation projects where the conditions with respect to sheep production are similar to those on the Minidoka project. Attention has been paid to cooperative grazing, and three cooperative sheep herds are now being grazed by settlers

on the Minidoka project on adjacent range areas. Cooperative selling of wool was successfully inaugurated on the Boise and Shoshone projects.

PASTURES.

On those reclamation projects where the dairy and sheep industries are specially important there is a strong demand for information regarding feasible methods of maintaining dairy cows and small farm flocks of sheep during the summer months. In this connection the use of irrigated pastures is almost universally desired. The work of the bureau in connection with pastures during the past year has been done principally on the Huntley and Shoshone projects, where the results secured at the Huntley Experiment Farm have been placed before the settlers in an effective manner. A large number of pastures have been established at points well distributed throughout the two projects, and substantial progress has been made. The results secured in this work during the early part of the past fiscal year stimulated a greatly increased planting of pastures during the spring of 1917.

SUPPLEMENTARY FEED CROPS.

On several of the projects some difficulty has been encountered in the production of crops to use in supplementing alfalfa, which is produced abundantly. The work of this office in the production of these supplementary feed crops has been done chiefly on the Truckee-Carson, Huntley, and Shoshone projects. On the Truckee-Carson project tests of varieties and cultural methods for wheat, oats, barley, corn, and mangels have been conducted in cooperation with farmers, and the results have been gratifying. Preliminary tests have also been inaugurated on the same project for the purpose of securing information as to satisfactory varieties and methods of production of silage corn. On the Huntley and Shoshone projects the work has had to do chiefly with the production of barley, wheat, and corn for silage.

IRRIGATION METHODS.

On the Umatilla project, in Oregon, where the topography is rough and the soil extremely sandy, the farmers have had serious difficulty in developing satisfactory methods of irrigation. A field man has been stationed on the project by this office and has devoted his time to assisting the settlers in improving their irrigation practices. This work necessitates in many instances a complete readjustment and rearrangement of the farm irrigation systems and equipment and securing a more efficient farm distribution of irrigation water. Improved methods of preparing new land for irrigation also are being put into practice by the settlers.

CROP UTILIZATION.

A METHOD OF SECURING UNIFORMLY MATURED SWEET CORN.

It has been found that the number of days that elapse between the time when the silks first appear and the time when the ear is in

prime condition for table use is practically constant for all varieties tried. In utilizing this discovery, ears are marked with dated tags on the day the silks appear. Sixteen days later these ears will be in prime condition and can be harvested rapidly without the necessity of opening the husks to judge the maturity. It is believed that this simple expedient will prevent losses that now result from the harvesting of immature and overmature ears. For home consumption the method also affords a means of gratifying individual preferences in the degree of maturity.

SWEET CORN RESISTANT TO THE CORN WORM.

Experiments directed toward securing a variety of corn combining the advantages of the well-protected ears of southern varieties of field corn with those of the sweet seeds of table varieties have been successful. The resulting worm-proof sweet varieties have now been tested for two seasons in comparison with other sweet varieties and have been found to possess a satisfactory degree of worm resistance. The utilization of these worm-resistant strains should bring about the extension of the production of sweet corn in the South, where at present the ravages of the corn worm practically prevent its cultivation. The results of these experiments have been submitted for publication.

CORN MEAL.

Various makes of small mills and hand sieves have been tested for grinding new corn into meal. Meals of exceptionally good qualities and of various degrees of granulation have been readily made by means of mills and sieves costing less than \$5. The greatest advantage from home grinding lies in the ability to select new, clean corn and grind, cook, and eat it while it possesses its fresh, rich oil and nutty flavor.

COTTON STALKS.

Because of the enormous aggregate tonnage of crop waste in the form of cotton stalks, the extravagant and continual claims as to their value as paper stock, and the demand for reliable information in regard to their possible paper-making value, considerable preliminary investigation has been made of this material and the following tentative conclusions have been reached:

In the first place, present methods of assembling this crop waste are too expensive to be practicable for commercial purposes. The economical assembling of the material at a cost which will be commercially profitable is beset with difficulties which have not as yet been removed.

The development of a process for pulping the material also involves real problems. The material is a mixture of plant structures differing considerably in physical and chemical characteristics, and the sizes or masses of the different components vary to a great degree. A blanket process for the pulping of the entire mass therefore becomes a difficult matter.

It has been determined that the caustic-soda process of pulping would not be justified by the quantity and quality of paper pulp

produced, while the sulphate process would not yield appreciably better results than the caustic-soda process. Preliminary tests on the application of the sulphite process, however, give more promise than any process which has yet been tried, but it is a question whether this process could be used in the warmer climates.

HEMP HURDS.

During the year 1916 it was determined by semicommercial tests that a No. 1 machine-finished printing paper could readily be produced from the waste of the hemp-fiber industry, and Department Bulletin No. 404, "Hemp Hurds as Paper-Making Material," was printed on paper produced from the hurds.

Because of the scarcity of raw materials for paper making and the increasing tonnage of hemp hurds, the matter was placed before a large paper company, with the result that the entire year's output of a hemp-breaking mill has been contracted for by a commercial firm. The hemp-breaking mill from which this supply of hurds will be obtained is the largest of its kind in the United States and was installed largely as a result of this investigation in 1916. It is anticipated that further expansion in this direction will take place in the next few years.

FLAX STRAW.

Considerable time and effort have been devoted to flax straw, the crop waste which aggregates about 1,500,000 tons per annum and is usually burned, with the exception of possibly 100,000 tons which is used in the manufacture of upholstering material and insulating boards.

The curtailment of imports of flax two years ago seriously interfered with the production of certain fiber boards and papers, and a great demand for flax fiber arose. Mill demonstrations were made to show that the present commercial grades of domestic flax tow could be used in place of the imported flax. As a result of a demonstration made with a fiber-board company in 1915, in which domestic flax tow was used, this company has used the material since that time, although they state that the practice will have to be discontinued unless a higher grade of tow can be produced. If this fiber-board market were developed satisfactorily, it would approximate the equivalent of 20,000 tons of flax straw. In 1916 this bureau demonstrated to a container-board company that domestic flax tow could be used in place of foreign fiber, especially if the grade of tow were improved. The potential market for flax in this industry is about 50,000 tons of straw.

As a direct result of studies in the field, numerous straw-buying stations are now established in northern Minnesota to purchase straw which has hitherto been burned. The possible demand for flax straw for use in the manufacture of fiber board, container board, and cartridge paper would probably approximate 100,000 tons.

The present low grade of commercial flax tow has been shown to be a serious drawback to the development of its use in the manufacture of paper and boards. This bureau has developed a process of tow manufacture by means of which tows can be produced which are far

superior to the present grades of commercial tows. Such high-grade tows are more readily and cheaply converted into paper than are the present commercial tows, and many companies which manufacture paper and fiber boards have stated that such tows would readily find a market in the paper industry. A public-service patent has been granted to the chemist who evolved the process, and a model machine has been constructed and installed in a large fiber plant in Minnesota, in order that a demonstration might be made and that the commercial practicability of the process might be judged by a practical tow manufacturer.

INVESTIGATIONS OF CROP HANDLING AND STANDARDIZATION.

COMMUNITY PRODUCTION OF DURANGO COTTON IN VIRGINIA.

The community production of Durango cotton in eastern Virginia is progressing satisfactorily. In the season of 1916 about 1,000 bales of Durango cotton were produced in this section, which sold at 28 to 30 cents a pound. Under the supervision of this bureau some 200 acres of selected Durango cotton are being grown for the purpose of producing superior planting seed. It has been found necessary to institute special studies of harvesting and ginning methods to meet the peculiar local conditions of humidity that generally obtain in the Dismal Swamp region during harvest time.

STUDIES OF THE STIMULATING EFFECT OF NEW CONDITIONS ON CORN.

It has been demonstrated that with the effects of selection eliminated the transfer of seed to a new locality results in an increase in vigor and yield the first year. Failure to recognize this factor would tend to an unwarranted confidence in the results of the first year following the introduction of a variety to a new locality. The results of experiments demonstrating the stimulating effect of change have been submitted for publication.

TRANSIT REFRIGERATION AND FREEZING INVESTIGATIONS.

Investigations begun during the fiscal year 1916 to determine the proper condition of fruits and vegetables for shipment were continued on a much larger and more extensive scale during the season of 1917. The work during the past year has conclusively demonstrated that aside from the factors of handling fruit and preparing it for shipment the most important factors in determining the condition of either fruits or vegetables in transit and after arrival on the market are the temperature and conditions obtaining in refrigerator cars during transportation.

Investigations during the past season have had in view mainly the improvement in refrigerator-car equipment, especially as regards insulation and facilities for free air circulation, in order to secure not only the greatest rapidity in cooling, but also to insure the maintenance of temperatures in transit sufficiently low to make possible the delivery at the markets of perishables, such as fruit and vegetables, in sound condition. The investigations have also included

studies of the relation of car insulation and other factors in construction to the protection of perishables against freezing. The results of the work thus far have entirely corroborated the results of the previous season and have clearly shown that through certain modifications in the construction of ice bunkers, the use of racks or false floors, and with better insulation and minor modifications in car construction it is entirely practicable and feasible not only to increase the efficiency of refrigeration, but to effect marked economies in the transportation of perishables.

The use of racks combined with the insulated bulkhead basket type of bunker makes possible a much more rapid refrigeration—that is, quicker cooling, the maintenance of lower temperatures in transit, more uniform temperatures throughout the load, and particularly the maintenance of lower temperatures in the top tiers in the middle of the car, where it is ordinarily very difficult to obtain satisfactory temperature conditions. With this kind of equipment it is entirely feasible to use small amounts of salt at the initial icing or during the first two or three icings in such a way as to accelerate the rapidity of cooling, in some cases to accomplish a quickness of cooling comparable to some extent with precooling in either warehouse or car-cooling plants. This rapidity of cooling can be accomplished with practically no extra cost and no delay for cooling, the extra amount of ice consumed during the cooling process being more than saved on reicing during the latter half of the trip, especially where cars are adequately insulated.

It has also been demonstrated to be entirely practicable to effect considerable economy as regards icing where cars are properly insulated and constructed. Not only does the modified type of bunker require less ice to accomplish the same refrigeration or better refrigeration than is now ordinarily obtained, but with adequate insulation a number of icings can be eliminated en route, resulting not only in a saving of ice, but in running time and the expense involved in switching, reicing, etc. Further economies are effected through the practicability of considerably heavier loading, making it possible to load the cars with a higher minimum than is now customary. This factor alone is one of very great importance, especially at this time, when there is such a serious shortage of cars for the movement of perishables and other foodstuffs.

The results clearly demonstrate that with improved car construction, proper loading, and judicious salting the upper tiers can be cooled to a temperature as low or nearly as low as that usually maintained in the bottom tiers under ordinary refrigeration with the present equipment. As there is no real problem at present in keeping the bottom tiers sufficiently cooled to carry perishables through to destination in good condition, it is readily seen that if it is possible and practicable to carry the top tiers at the temperatures now ordinarily maintained in the bottom tiers it is entirely feasible to markedly improve the condition in which vegetables arrive on the market and to eliminate a vast amount of deterioration and economic losses now due to the poor condition in the top tiers of perishables. It also makes possible the shipment of tree-ripened or more fully matured fruit in good condition, thus supplying the consumer with a product possessing the maximum of good eating quality.

The freezing investigations have clearly demonstrated that a little more insulation, with the provision of floor racks, will eliminate over 90 per cent of the freezing now occurring in the shipment of citrus fruits from California. This freezing protection is not only related to insulation and floor racks, but also to heavier loading. In fact, the refrigerator-car investigations, both as regards efficiency and economy of refrigeration and the protection of perishables against freezing during severe weather, indicate that whatever improvements are made to increase the efficiency and economy of refrigeration likewise make for the more adequate protection of perishables against freezing. While some investigation is being made of heater equipment, the investigations indicate that freezing protection is fundamentally related to the insulation and construction of the refrigerator car, supplemented with proper loading. They also indicate that, as regards economy and efficiency the year round, it is going to be a more fundamentally sound and economical proposition to provide protection for perishables against freezing through proper car construction and the provision of sufficient insulation than by the installation of expensive and uncertain heater equipment that is useful only during the freezing season.

These investigations have been conducted in close cooperation with similar investigations with regard to poultry and fish in the Bureau of Chemistry.

NORTHWEST APPLE STORAGE.

Several new phases of the general fruit-storage problem were developed in the investigations conducted during the past year. The relation between keeping quality in the storage of apples and methods of handling in the harvesting, grading, and packing of the fruit, the stage of maturity at which fruit for storage should be harvested, and the importance of prompt cooling in the storage of fruit were subjects of further investigation in the Northwest. The results indicated particularly that fruit intended for storage in air-cooled warehouses requires an equal or even a greater degree of care in handling in all the operations of preparing the fruit for market than has been found to apply to fruit held in cold storage.

Aside from the problems connected with methods of handling, the results of the apple-storage investigations have clearly shown that the two most vital problems relating to the successful storage of apples in the Northwest are the proper design and construction of common storage warehouses and the efficient management of these air-cooled storage houses. The work emphasized especially the importance of improvements in the methods of management of air-cooled storage houses. A careful investigation of the efficiency of the common storage houses in use indicated that the most important features in the construction of these warehouses are adequate insulation and more efficient means of providing ample ventilation to insure maximum cooling at night by natural air circulation. The data secured clearly show that the rate of cooling of fruit immediately after storage is almost wholly dependent upon the methods of storage and the arrangement and size of ventilators provided, and in this respect there is a general need for improvement in the means provided to insure the adequate and prompt initial cooling of the fruit. In a com-

parison of the data secured from the storage of different varieties of apples in cold storage and of comparable lots in common storage, it was shown that under ordinary conditions common storage is markedly inferior to the best cold-storage facilities provided in the modern refrigerated storage warehouses.

The importance of common storage in the handling of the northwestern apple crop further emphasizes the need of greater efficiency in the operation as well as in the design and construction features of these houses, in order to stabilize this important feature of the apple industry in the Northwest. In addition to the studies relating to temperature conditions, the common storage methods of supplying and regulating humidity and the influence of the proper degree of humidity upon the keeping quality of apples have been given full consideration. The means suggested for maintaining the desired humidity conditions in the air of the storage rooms as a result of the investigations should displace the more or less ineffective methods formerly used.

The problems relating to the handling of the fruit crop in the Northwest are becoming increasingly difficult, owing to the necessity of handling the increased production of fruit with an inadequate labor force. The standards of careful handling have been harder to maintain, and, in general, the results of investigations demonstrated that in the aggregate the losses in storage due to faulty handling alone constitute one of the most serious problems confronting the apple growers and shippers in the Northwest. The two factors of careful handling and prompt storage, together with increased storage facilities of a more efficient type, constitute the principal lines along which the handling and storage investigations in the Northwest have been directed during the past season.

CALIFORNIA APPLE STORAGE.

The apple-storage investigations in the Watsonville district of California were continued along the lines indicated in the work during the past two or three seasons. Further data were secured in the storage of fruit subject to the typical internal browning affecting these apples in cold storage, and the results fully substantiate the conclusions that storage browning in the Watsonville district is closely related to the condition and vigor of the trees. While the data show that browning develops to the greatest extent at low temperatures in storage and that 36° F. is a more desirable temperature for the storage of these apples than 32°, the differences in the fruit from very vigorous and from weak or sickly trees show that the factors relating to the care of the trees and sanitary orchard practices have an important bearing upon the life of the fruit in cold storage. In general, the data indicate that by correcting unfavorable orchard conditions it may be possible to overcome the tendency of the fruit to develop storage browning, and the storage records from individual trees may have a further value in indicating that the fruit from the healthy, vigorous trees may be desirable for long storage while fruit from the less thrifty or diseased trees in the orchard should not be placed in storage, but should be disposed of during the harvesting season for immediate consumption.

Having in view the severity of Watsonville browning in general and the serious difficulty experienced in the marketing of these apples after they have been held in cold storage, any feasible method of segregating fruit which can be safely held in cold storage from fruit which develops the browning would be of great value to the apple industry of California.

MODEL COMMON-STORAGE WAREHOUSE PLANS.

In connection with the investigations of the efficiency of common-storage houses, important principles were developed relating to the design and construction of suitable types of warehouses adapted to different districts and climatic conditions. Detailed plans for an improved type of common-storage house at Winchester, Va., were designed, in which special methods of precooling the fruit by means of an auxiliary refrigerating plant using ice and salt were provided, supplemented with ample means of cooling during the regular season by natural ventilation.

VEGETABLE HANDLING AND STORAGE.

The principal storage work with vegetables was with sweet potatoes. Well marked and sharply defined results were secured from this work. The results are summarized as follows:

In a storage experiment to determine the difference in keeping quality of the various varieties, 36 varieties were stored for 150 days. The average loss by decay was less than 0.5 of 1 per cent. Seventeen varieties showed no decay, seven varieties less than 0.5 of 1 per cent, five varieties between 0.5 and 1 per cent, two varieties between 1 and 2 per cent, one variety between 2 and 3 per cent, one variety 3.5 per cent, and three varieties between 5 and 10 per cent.

In an experiment to determine the best temperature for storage, three standard varieties of sweet potatoes were used and lots of each variety were placed in each of three rooms. In one room the temperature was maintained from 50° to 55° F., in the second room from 55° to 60°, and in the third room from 60° to 65°.

The shrinkage in the three rooms and for the three varieties of potatoes was as follows:

Temperature.	Days in storage.	Shrinkage.	Variety.	Days in storage.	Shrinkage.
		<i>Per cent.</i>			<i>Per cent.</i>
50° to 55° F.....	152	14.1	Big Stem Jersey.....	152	10.8
55° to 60° F.....	152	12.5	Nancy Hall.....	152	11.9
60° to 65° F.....	152	16.4	Southern Queen.....	152	14.4

The amount of decay was so small that comparisons would not amount to much. However, in the Nancy Hall variety there was no decay and in the other two the average was less than 1 per cent.

TIMBER DECAY.

The age limit at which decay reaches practical importance has been determined for incense cedar and white fir. Definite external

symptoms of decay in these species have been found and described, which enable marking and scaling to be done much more closely and accurately. Its costs as much to cut a defective tree, to buck a defective trunk, or to take an unsound log from the woods to the mill as it does to go through the same process with a sound and usable unit. Such expenses can now be avoided by close attention to the external symptoms of decay. For example, before the recent increases in cost of labor, it cost on the average \$7.50 per thousand board feet to get logs of incense cedar to mill. This expense can now be avoided in the case of defective logs.

INVESTIGATIONS OF THE QUALITY OF SEED.

FORAGE PLANTS.

The importation of forage-plant seeds during the year varied from that of 1916 principally as follows: Nearly four times as much alsike, one-sixth as much red clover, and 50 per cent more rape and orchard grass were imported. In 1917 about 300,000 pounds of hairy-vetch seed was imported, as compared with 67,000 pounds in 1916 and 2,500,000 in 1914. This seed is of Russian origin and recent importations have been confined to those coming through the port of Archangel.

SEED LABELING.

At the request of the Secretary of Agriculture representatives of the seed trade met in Washington on May 10, 1917, to confer with officers of the Department to consider a plan whereby the seed trade would furnish essential information as to the quality of all field seeds they sell. Definite suggestions were presented and accepted by those present at the conference and later approved by the trade associations at their annual conventions in June. This plan provides that all field crop seeds sold after July 1, 1917, in lots of 10 pounds or over shall be accompanied by the following information:

- (1) Name of seedsman.
- (2) Kind of seed.
- (3) Proportion of pure live seed present, with month and year of germination test.
- (4) Country or locality of origin in the case of the following imported seeds: Beans, soy beans, Turkestan alfalfa, and red clover from southern Europe and Chile.

All information either to be on labels securely attached or to be stenciled directly on sacks or other containers.

PRODUCTIVITY OF CORN.

Each year's work makes it more evident that other factors influencing corn yields can not be satisfactorily studied without attention to the quality of the seed. The productivity of seed corn is determined by its heredity, the conditions under which it was grown, and the conditions under which it was kept during its dormant period previous to planting. A difference as great as 18 bushels per acre has been found, due solely to conditions to which the seed was subjected during its dormant period, which conditions did not injure

viability. The recognition of the fact that by proper preservation seed corn will retain its viability and productivity for three or four years makes the planting of poor seed unnecessary. An extension of the practice of always holding a two-years' supply of seed will facilitate the improvement and adaptation of high-yielding varieties and prevent their extinction through destruction of the corn crop by droughts or frosts.

Corn production is found to be on the increase in localities surrounding and quite remote from the principal centers of production. In the Southeastern States, where both rainfall and heat are sufficient, corn production is rapidly increasing. With sufficient heat and rainfall assured, record yields are made by supplying ample plant food. The change in the rate of planting from that which a poor soil could support to that which abundant rainfall would permit, combined with liberal applications of vegetable matter and fertilizing material, is producing wonderful increases in acre yields and total production.

EXPLOITATION OF DOUBTFUL NEW VARIETIES OF WHEAT.

The late wheat shortage and high prices have caused unprecedented interest in wheat and naturally accompanying attempts to exploit so-called new strains without warrant of adaptation or demonstrated yield or quality. By prompt communication with promoters and the publication of warnings to the public, such exploitations usually have been checked before serious harm was done.

REPORT OF THE FORESTER.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FOREST SERVICE,
Washington, October 1, 1917.

SIR: I have the honor to transmit herewith a report of the work in the Forest Service for the fiscal year ended June 30, 1917.

Respectfully,

ALBERT F. POTTER,
Acting Forester.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

THE NATIONAL FORESTS.

Again, as in the fiscal year 1916, the receipts from the National Forests touched a new high level. Their total was \$3,457,028.41. The increase over the previous year was \$633,487.70.

Practically every form of use of the Forests was greater than ever before, and every revenue-producing activity contributed to the gain except sales of turpentine privileges—a small item, since these sales are made only on the Florida Forest. The chief increases were in timber receipts, which totaled \$1,692,520.21, and in grazing receipts, with a total of \$1,549,794.76.

The increase from timber over 1916 was \$265,525.71, and from grazing \$339,580.17. The former was due to improved market conditions which stimulated cutting under old contracts for large sales and also resulted in a greater number of new sales, both large and small. The increase in revenue from grazing came chiefly from the higher schedule of charges introduced in the spring of 1917. It was also partly the result of more intensive utilization of the range.

The reasons for raising the rates of charge for the grazing privilege were set forth in last year's report. An advance was made for the 1917 season of 25 per cent. This did not carry out in full the principle that the charge should represent the actual value of the grazing privilege. In November, 1916, the Secretary of Agriculture proposed a plan for an advance in the fees of 100 per cent, in three annual installments. Opportunity was then given for live-stock interests to be heard regarding its fairness. As a result of hearings and conferences, the plan was modified. In view of the possibility that the real value of the grazing on different Forests or in different general localities varies to such a degree that the full increase might

not everywhere be justified, the Secretary of Agriculture determined upon an increase of 25 per cent for the first year. At the same time he announced that further increases would be deferred until a specific study of the existing conditions upon each of the National Forests had been made. Upon the basis of the facts thus obtained, it was stated, additional increases would be made when the real value of the forage upon any Forest was found to be more than the amount charged, but not to become effective before March 1, 1918.

When the grazing charge has been advanced to cover the full value of the grazing privilege, the income from the National Forests will be close to the cost of operation. The present annual operating cost is about \$4,000,000—less than \$600,000 in excess of the receipts last year. An increase in receipts equal to that which took place in 1917 would close the gap.

In this connection the improved demand for National Forest timber calls for brief comment. A 19 per cent gain in the receipts for timber followed a 20 per cent gain in 1916. Last year's report characterized the gain in 1916 as somewhat abnormal. It was then pointed out that the improved situation did not bring any increase in the amount of timber put under contracts for sale, but merely accelerated the cutting under old contracts. The sale contracts made in 1917 show a striking contrast, since the total volume of sales was more than twice the total of the previous year.

Unquestionably general conditions affecting the lumber industry improved very materially in 1917, and were reflected in the increased demand for sale contracts as well as in the increased cut and receipts. This is primarily attributable to business activity throughout the country. After the entrance of the United States into the war some further stimulus was given to the lumber business by the orders for material for construction purposes on behalf of the Government. Nevertheless, the basic situation in the lumber industry has not changed. An enormous overload of stumpage in private hands and manufacturing facilities far in excess of the capacity of the country to absorb the output are still matters to be reckoned with. Whether the gain made for the last two years will characterize the year 1918 is altogether uncertain.

The urgent need pointed out in former reports for larger provision for road building in the interest of local and community development was met by the law passed July 11, 1916, commonly known as the Federal aid road act. Section 8 of this act appropriated for roads and trails within or partly within National Forests, and made available until expended, \$1,000,000 for the fiscal year 1917 and an equal amount for the nine succeeding years. Immediately upon the passage of the act the formulation of a plan for carrying out the law was undertaken, and on September 1, 1916, regulations embodying the plan were approved by the Secretary of Agriculture. The details of the plan are given later in this report. Eventually this road work will be of very great value in promoting the economic and social progress of many localities now meagerly provided with means of communication and unable to provide them unassisted, and the local development thus promoted will also enhance the usefulness of the Forests to the public and the revenue which the Forests yield.

A decision of the Supreme Court of the United States, rendered March 19, 1917, that certain water-power companies operating in the

State of Utah were occupying and using reserved lands of the United States without its permission and contrary to its laws was of the utmost importance to National Forest administration, because it disposed of contentions which denied not only the statutory authority for the regulation of water-power development on National Forest lands, but also the constitutionality of such regulation by the Federal Government. That the regulations under which extensive development of water power on the National Forests has actually taken place are not onerous and do not tie up this important resource has been fully demonstrated. With the jurisdiction of the Government over its own lands clearly established, even though, as was said in the decision of the court, this may involve the exercise in some measure of what is commonly known as the police power, the desirability of a good leasing law is reinforced. Such a law should stimulate further development by affording investors a better guaranty of security for their period of tenure. This is entirely compatible with full protection of the rights of the public and prevention of monopolistic control of the resource by private interests.

CHANGES TO MEET WAR CONDITIONS.

Upon the rupture of diplomatic relations with Germany the Forest Service began to plan for meeting the responsibilities which, if war followed, it should assume. These included the rendering of emergency assistance in special patrol duties in the National Forest regions, particularly in the protection of public works and transportation lines; the gathering of military reconnaissance information valuable to the War Department; the release for war service of such portion of its personnel as might be needed because of qualifications for special forms of activity or such as might have to be spared for military service, either as volunteers or under draft; and the rendering of advice or assistance to the War and Navy Departments and to manufacturers in matters relating to the supply of materials derived from the forests and required for war purposes.

Wood and other forest products have almost innumerable uses in modern warfare. Never before have requirements been so exacting nor has the demand for exact knowledge of the properties of wood, mechanical, physical, and chemical methods of conditioning, and the best technique in construction, and for specifications based upon scientific tests been so urgent. A very large part of all the technical data secured during the research work on wood, initiated by the Government approximately 25 years ago, finds immediate and important application in some war problem.

The first step taken was to ascertain the qualifications of all male employees for various classes of service and to work out for each National Forest and district office the possible readjustments of personnel and modification of activities which could be made in case of necessity, whereby men and funds could be set free for war needs without bringing to a halt work no less important in times of war than in peace. Obviously, provision for the continued use of timber and forage resources of the Forests and for their protection against fire could not be abandoned, but on the contrary would be even more essential (if that is possible) under war conditions than in ordinary times. Through careful foresight the Forest Service made itself

prepared, so that all demands upon it were met as they arose. The entrance of a considerable number of men into military service took place without disorganization of the administrative and protective force. Upon request of the War Department the preliminaries of recruiting and officering the Tenth Engineers (Forest) were handled. Increase of crop production in and near the Forests was stimulated and the forage resource of the Forests was made available for emergency use up to the limit of safety. In the latter part of the summer a fire season of extreme danger, made worse in some localities by an unusual prevalence of incendiarism, was passed through with relatively small loss of property and with no reported loss of life.

The decision of the War Department to organize as a part of the Engineer branch of the service a special force for forest work followed a request from Great Britain for a regiment made up of men skilled in lumbering and sawmill operating, to assist in the production in France of timber products required by the British Army. Since all French forests are managed under the careful practice of forestry, to meet the request a regiment was needed which could meet the special conditions imposed by this fact. The assistance of the Forest Service in raising it was therefore sought. Officers were selected for recommendation to the War Department, of whom a majority were trained foresters. For the rank and file woodsmen and millmen were drawn from all the main lumber regions of the country. To make preliminary arrangements for the work of the regiment and for similar work by such additional units as might be needed later the forester received leave of absence from the Department of Agriculture, and was sent abroad by the War Department as a major attached to the staff of the commander of the American Expeditionary Force. A number of other members of the Forest Service have been commissioned by the War Department in connection with the work. Owing to the very large needs of our own expedition for wood supplies abroad it has become necessary to plan for a considerable addition to the forestry force already sent to France.

In the work relating to forest utilization and forest products, the resources of the Service have been employed to the limit of their capacity since the war began in rendering assistance to the War and Navy Departments, the Emergency Fleet Corporation, various committees of the Council of National Defense, and manufacturers of war orders. The peace-time program has been largely discontinued. The force and the work have been centered in Washington and Madison. Every effort has been made to bring available knowledge to the attention of the organizations which have need for it and to assist in anticipating their problems.

On aircraft the efforts of the Service have included the development of methods by which spruce and ash can be artificially dried without loss of strength and toughness, obviously involving supplementary strength tests; tests to determine the best substitutes for these species, and for each species selected the development of safe methods of artificial drying; study of the effects of steaming on mechanical properties of ash and spruce, to develop the best conditions for bending; the selection of the woods most suitable for propellers; tests to determine the proper methods of conditioning and

the best technique for propeller construction; strength tests on veneers and built-up construction; advice and assistance on specifications; and the training of inspectors of wood for airplanes.

On wooden ships an attempt is being made to cover the whole field of the proper technical use of wood, including specifications, the best methods of conditioning, preservative treatment against decay and marine borers, the selection of substitutes, steaming and bending, etc.

Efforts on vehicles have been centered mainly on the development of methods of drying the hardwoods which are used, and assistance to manufacturers in putting the best methods into commercial practice. Wherever possible assistance has been given to hardwood distillation plants in order to increase the production of acetone and other products so greatly in demand for munitions making. A commercial demonstration has shown that the cost of producing ethyl alcohol from wood waste can be materially reduced. Profitable production is important from the standpoint of munition making, and also food conservation. Methods have been developed in commercial demonstrations under which walnut and birch can be kiln dried for gun stocks in a much reduced time with comparatively little loss.

In general, much assistance has been given on a great variety of war problems relating to forest resources and the manufacture, purchase, and most efficient use of wood and other forest products.

Data urgently needed as a basis for airplane design and construction, regarding such matters as the selection of the best species and the best substitutes, the development of safe methods of artificial drying, and the best technique in construction, can not be supplied as rapidly as they are needed with the present force and equipment. An increase in funds for this important work is urgently called for.

AREA AND ORGANIZATION CHANGES.

A total gross area of 644,050 acres was added to the National Forests, as follows: By presidential proclamation, 34,560 acres to the Crook, in Arizona; by acts of Congress, 1,292 acres to the Pike, in Colorado, 13,642 acres to the Teton in Wyoming, and 4,480 acres to the Missoula in Montana; and by presidential proclamation, under authority of special acts of Congress, 50,182 acres to the Whitman, in Oregon, and 539,901 acres to the Colorado Forest, in Colorado. Oregon and Colorado are among the seven States in which additions require special legislation.

Eliminations were made by presidential proclamations and Executive orders from 12 Forests, to a total gross area of 316,230 acres. There was also eliminated, through final approval by the Interior Department of certain State selections in two Forests in Idaho and South Dakota, a total of 37,581 acres, under the terms of previous proclamations which made the land available for exchange with these States but under which the elimination did not become effective until the State selections were approved. By acts of Congress there were eliminated 83,453 acres from the Lassen and Colorado Forests, for inclusion in the Lassen and Rocky Mountain National Parks.

There were within the National Forest boundaries June 30, 1917, 176,252,160 acres, including 21,085,541 acres of alienated land. The net National Forest area, or, in other words, the area actually owned by the public, was at the close of the year 155,166,619 acres.

This is 233,190 acres less than the total net area June 30, 1916. Both the gross and the net area of the National Forests reached their maximum in 1910, when the boundaries at one time included 194,538,532 acres, and the amount in public ownership was in the neighborhood of 172,000,000 acres. For a number of years the National Forest area had been rapidly augmented, for the most part on the basis of reconnaissance examinations which left for later determination the most desirable permanent boundary line. In 1909 plans for a thoroughgoing revision of the boundaries were inaugurated. These plans contemplated both the exclusion of lands within the Forests not permanently best suited to forest purposes and the inclusion of lands without the Forests best suitable for inclusion. The process of building up the Forests had, however, somewhat outstripped the development of methods of use and the growth of public opinion regarding the desirability of permanent Government ownership and management of the properties. In 1907 Congress incorporated in the Agriculture appropriation act a provision that no additions should be made to the Forests in the States of Washington, Oregon, Idaho, Montana, Wyoming, and Colorado, and in 1910 California was added to the list. Since early in 1910 the area in the Forests has been undergoing steady reduction.

Fundamentally this has been the outcome of land classification. The primary object of this work has been to discover and open to settlement, either through eliminations or under the forest-homestead law, areas better suited to agricultural than to forest use. Secondary considerations have been the elimination of lands which, either because of their low value for Forest purposes or their relatively high percentage of private holdings, do not justify the cost involved in their administration. The natural complement of this process of sifting out the lands which it is undesirable, from the standpoint of public interests, to retain would be a similar classification of lands outside the Forests which are still public property and which would best serve the public welfare if added to them. Where possible this has been done. In the States within which Congress has prohibited additions by Executive action, however, additions must, as a rule, await the development of a definite local demand for administration of specific areas by the Forest Service sufficient to bring about legislation.

By Executive orders effective July 1, 1917, the Santa Rosa, Ruby, and Humboldt Forests in Nevada were combined in one Forest, to be designated as the Humboldt; the Chiricahua and Coronado in New Mexico and Arizona were combined in one Forest to be known as the Coronado; the Alamo and Lincoln Forests, New Mexico, were combined in one Forest to be known as the Lincoln; and the Palisade and Targhee Forests in Wyoming and Idaho were combined under the latter name. In consequence of these changes the number of National Forests at the beginning of the new fiscal year was 147, as against 152 on July 1, 1916.

ALIENATIONS AND LAND CLASSIFICATION.

There were passed to patent 1,208 tracts of land within the National Forests, as against 1,491 in 1916 and 881 in 1915. Of these 730 were homesteads, as against 761 in 1916 and 360 in 1915. Mineral claims patented were 426, as against 703 in 1916. Patents were also issued

for 11 timber and stone claims, 8 coal claims, 6 desert-land entries, and 27 miscellaneous entries.

Excellent progress was made in classifying and opening to entry the remaining agricultural lands in the Forests. At the close of the fiscal year a total area of 127,156,610 acres had been covered by field examinations and the classification approved by the Secretary of Agriculture. Of this total about 57,000,000 acres was covered during the past year. There now remain to be examined and classified slightly less than 50,000,000 acres, including 21,000,000 acres in the National Forests of Alaska. In carrying on the work every effort has been made to dispose first of those areas which would make available for settlement most quickly and with the least effort the greatest area of land suitable for farming purposes. It is believed that by far the greater part of the agricultural land has now been made available for homestead settlement and entry, either by listings under the forest homestead act or by elimination. Nevertheless, much work remains to be done before the classification work is completed. This is largely due to the fact that the most difficult lands have been left to the last.

Since the passage of the act of 1912, providing funds for land classification, and as a direct result of classification work, 12,039,736 acres have been eliminated from the National Forests. The effect is very clearly shown in the marked falling off of applications under the forest homestead act. In 1915 the total number of applications received was 4,433. In 1916, owing to the large progress made in classifying and opening the agricultural land, the applications dropped to 2,589, a reduction of 41 per cent. In 1917 the number again dropped to 1,373, a reduction of 47 per cent. A corresponding reduction is shown in the number of individual tracts opened to entry under the forest homestead act. In 1915 the total was 2,356; in 1916, 1,102; in 1917, 843.

FOREST MANAGEMENT.

The total amount of timber cut from the Forests in 1917 was 840,612,000 board feet, as against 714,505,000 board feet in 1916.¹ The amount of timber sold was more than double that in the previous fiscal year. This increase in sales occurred both in small sales for local use and in large sales for the general market. In all, 11,608 sales were made, of which 4,686 were at cost rates to homestead settlers and farmers under the act of August 10, 1912. As cutting operations on the large sales made during the year reach their full development, they should normally result in a still larger cut and larger receipts than those of last year. At the close of the fiscal year labor troubles in the Northwest had caused a temporary suspension or reduction in operations on some sales.

¹ In the Report of the Forester for 1916 the total cut was given as 864,920,000 board feet. Through an error in computation the figures for quantity and value of timber sold in Montana and northern Idaho were interchanged with the corresponding figures for quantity and value of timber cut. The correction of this error results in the substitution of the following figures in place of those reported last year: Timber sold under commercial sales, fiscal year 1916—Idaho, 73,741,000 board feet, with a value of \$157,495.07; Montana, 42,585,300 board feet, with a value of \$88,897.03; total in all States, 834,004,000 board feet, value \$1,654,999.92; grand total of commercial and cost sales, 857,321,000 board feet, value \$1,672,249.77. Timber cut under commercial sales—Idaho, 69,826,000 board feet, value \$164,508.64; Montana, 94,552,000 board feet, value \$203,004.27; total in all States, 573,552,000 board feet, value \$1,241,104.90; grand total of commercial and cost sales, 595,022,000 board feet, value \$1,255,600.75. The average price obtained for timber placed under contract in commercial sales in 1916 was \$1.98 per thousand board feet, instead of \$2.01, and the average price per thousand obtained in sales at cost rates was \$1.24 less than that obtained in commercial sales, instead of \$1.27.

The timber business on the eastern purchase areas, while still small in amount compared with that on the western Forests, showed a decided increase. From these purchased lands 22,317,000 board feet, valued at \$51,544.49, were sold, as against 6,279,000 board feet, valued at \$6,369.23 in 1916, and 5,435,000 board feet, valued at \$7,315.54, were cut, as against 3,875,000 board feet, valued at \$3,992.70, in 1916. The material taken in these sales is largely of poor quality, and its removal is an aid in improving the composition of the stand. In a few cases the value of the material sold has equaled the price paid by the Government for the land and timber. This has been due to the marked increase in the value of some minor forest products, such as chestnut acid wood.

An aggregate of 113,073,000 board feet of timber, valued at \$149,801.86, was cut and removed from the National Forests under the free-use privilege by approximately 41,427 users. Over 17,000,000 board feet of this material was secured from free-use areas without written permit by over 13,000 users.

The average price of \$1.86 per thousand feet received for timber placed under contract in commercial sales during the year is 14 cents less than the average for the year 1916. This is due to the sale of large amounts of low-priced timber in the Pacific Northwest, and it is no indication of the average market value of the timber on all National Forests. The average price received varies somewhat from year to year, according to the location of large sales and the kind of timber involved in them.

The quantity and value of timber sold and timber cut under commercial sales is given by States in Table 1. In compiling this table material of all kinds was converted into board feet log scale.

TABLE 1.—*Timber sold and cut under commercial sales, fiscal year 1917.*

State.	Timber sold.		Timber cut.	
	Board feet.	Value.	Board feet.	Value.
Alaska.....	46,385,000	\$61,256.39	46,621,000	\$59,917.14
Arizona.....	67,195,000	161,215.90	52,845,000	120,661.25
Arkansas.....	24,192,000	86,182.56	16,807,000	53,277.05
California.....	122,133,000	286,599.66	66,643,000	143,352.01
Colorado.....	44,696,000	76,745.61	38,864,000	70,125.70
Florida.....	983,000	2,077.95	483,000	1,252.77
Georgia.....	196,000	330.01	142,000	260.84
Idaho.....	257,316,000	581,962.49	84,278,000	200,592.06
Michigan.....	129,000	278.10		
Minnesota.....	755,000	2,222.87	3,582,000	10,672.72
Montana.....	194,124,000	452,113.30	101,978,000	244,353.41
Nevada.....	1,906,000	3,890.46	1,391,000	2,352.26
New Hampshire.....	9,667,000	24,129.00	544,000	3,130.00
New Mexico.....	163,183,000	252,616.29	43,837,000	96,415.00
North Carolina.....	2,594,000	3,742.54	1,028,000	961.68
Oklahoma.....	25,000	21.25	25,000	21.25
Oregon.....	688,513,000	1,159,018.95	102,461,000	233,255.37
South Dakota.....	32,132,000	64,487.02	22,198,000	51,924.11
Tennessee.....	1,765,000	3,768.62	1,890,000	927.39
Utah.....	10,944,000	21,613.33	16,869,000	44,104.82
Virginia.....	8,095,000	19,574.31	1,831,000	2,035.63
Washington.....	290,778,000	388,547.18	80,645,000	106,603.74
Wyoming.....	15,632,000	43,720.55	21,719,000	45,011.17
Total 1917.....	1,982,438,000	3,695,114.34	706,681,000	1,491,207.37
Total 1916.....	834,004,000	1,654,999.92	575,552,000	1,241,104.90
Total sales and cut, 1917:				
Commercial.....	1,982,438,000	3,695,114.34	706,681,000	1,491,207.37
Cost.....	25,649,000	20,311.80	20,858,000	16,095.66
Grand total.....	2,008,087,000	3,715,426.14	727,539,000	1,507,303.08

In addition, turpentine rights aggregating 209,850 cups were sold for \$9,272.82 on the Florida Forest. The average return of \$44.35 per thousand cups is somewhat less than that received in the previous year, on account of the shorter period covered by some of the contracts.

The number of timber sales, classified by value, and the number of sales at cost, practically all of which are for less than \$100, are given in Table 2.

TABLE 2.—*Number of timber sales, classified according to amount of sale, and number of cost sales, fiscal year 1917.*

State.	\$100 or under.	\$101 to \$500.	\$501 to \$1,000.	\$1,001 to \$5,000.	Over \$5,000.	Total.	Sales at cost.
Alaska.....	441	4	6	8	1	460	.....
Arizona.....	1,092	4	10	5	6	1,117	143
Arkansas.....	96	10	5	11	4	126	49
California.....	902	17	8	12	11	950	387
Colorado.....	890	18	11	14	2	935	293
Florida.....	19	1	.....	.....	.....	20	.....
Georgia.....	11	.....	.....	.....	.....	11	.....
Idaho.....	1,569	16	7	14	15	1,621	879
Michigan.....	1	1	.....	.....	.....	2	.....
Minnesota.....	21	3	1	.....	.....	25	.....
Montana.....	2,508	24	9	15	11	2,567	1,501
Nevada.....	184	.....	.....	.....	.....	184	1
New Hampshire.....	23	.....	1	2	2	28	.....
New Mexico.....	431	3	7	8	6	455	179
North Carolina.....	35	1	2	1	.....	39	.....
Oklahoma.....	1	.....	.....	.....	.....	1	.....
Oregon.....	741	4	5	2	6	758	522
South Dakota.....	626	3	2	6	4	641	205
Tennessee.....	19	.....	.....	1	.....	20	11
Utah.....	844	13	3	.....	1	860	270
Virginia.....	107	3	.....	.....	.....	115	.....
Washington.....	335	8	4	6	.....	359	113
Wyoming.....	305	6	.....	.....	3	314	133
Total, 1917.....	11,201	139	83	107	78	11,608	4,686
Total, 1916.....	10,496	133	60	122	39	10,840	4,433

Table 3 gives, by States, the quantity and price of the sales at cost and the quantity and price of the cut.

TABLE 3.—*Timber sold and cut at cost rates, fiscal year 1917.*

State.	Number of sales.	Timber sold.		Timber cut.	
		Quantity.	Value.	Quantity.	Value.
		<i>Board feet.</i>		<i>Board feet.</i>	
Arizona.....	143	808,000	\$320.60	242,000	\$233.56
Arkansas.....	49	1,145,000	2,198.95	658,000	1,480.44
California.....	387	1,852,000	1,088.31	2,350,000	1,233.53
Colorado.....	293	1,900,000	1,477.55	1,697,000	1,306.94
Idaho.....	879	4,715,000	3,628.68	3,879,000	3,040.48
Montana.....	1,501	7,849,000	6,078.12	5,809,000	4,556.44
Nevada.....	1	1,000	75	45,000	37.35
New Mexico.....	179	533,000	508.21	359,000	337.63
Oregon.....	522	2,887,000	1,623.76	2,495,000	1,466.89
South Dakota.....	205	1,613,000	1,273.66	1,212,000	1,022.69
Tennessee.....	11	23,000	17.12	3,000	2.39
Utah.....	270	802,000	619.73	634,000	478.20
Washington.....	113	713,000	370.03	794,000	403.46
Wyoming.....	133	1,150,000	1,106.33	620,000	491.66
Total, 1917.....	4,686	25,649,000	20,311.80	20,858,000	16,095.66
Total, 1916.....	4,433	23,317,000	17,249.85	19,470,000	14,495.85

The average price of the timber cut was 77 cents per thousand feet, b. m., or \$1.09 less than the average price obtained in commercial sales.

The free-use business of the year is shown in Table 4.

TABLE 4.—Amount cut under free-use permit and from free-use areas, fiscal year 1917.

State.	Number of users.	Timber cut.	
		Board feet.	Value.
Alaska.....	6	7,973,000	\$7,718.50
Arizona.....	3,559	6,904,000	19,449.00
Arkansas.....	50	63,000	96.60
California.....	3,094	7,773,000	11,215.86
Colorado.....	3,545	8,729,000	11,271.48
Florida.....	89	176,000	358.90
Georgia.....	101	26,000	25.60
Idaho.....	7,773	20,953,000	29,981.78
Michigan.....	17	105,000	28.15
Minnesota.....	39	57,000	114.00
Montana.....	3,761	9,456,000	14,080.38
Nebraska.....	6	3,000	30.00
Nevada.....	575	1,605,000	2,730.22
New Mexico.....	6,650	10,084,000	19,383.00
Oklahoma.....	556	205,000	113.00
Oregon.....	2,406	10,995,000	9,161.07
South Dakota.....	1,331	5,078,000	5,245.68
Tennessee.....	70	274,000	144.00
Utah.....	5,584	13,977,000	9,886.16
Virginia.....	33	104,000	61.29
Washington.....	363	1,256,000	1,203.17
West Virginia.....	2	5,000	2.50
Wyoming.....	1,822	7,209,000	7,501.52
Total, 1917.....	41,427	113,073,000	149,801.86
Total, 1916.....	42,076	119,483,000	184,715.08

Of the amount cut in Alaska, 7,358,000 board feet was secured by the Alaskan Engineering Commission, under a permit issued in accordance with the act of March 4, 1915. No attempt has been made to estimate the amount taken without permit from the Alaskan Forests under the regulations of the Secretary of Agriculture, or the number of persons in the Territory availing themselves of the privileges afforded by these regulations.

EXTENSION OF TIMBER ESTIMATES.

During the year 395,892 acres of National Forest timberlands were estimated and mapped on an intensive basis, and 704,267 acres on an extensive basis. In all, 21,205,820 acres of Forest lands have been estimated and mapped by intensive methods, and 48,002,570 extensively. This mapping and estimating has been an essential preliminary to the making of large sales, since otherwise it would be impossible to make an accurate appraisal of the stumpage value. With the increase in the timber business on the National Forests it is necessary to increase correspondingly the amount of this work, both to meet the needs of new applicants and to prepare for new sales to companies which are completing large sales made in former years.

At the close of the fiscal year large sales aggregating over 400,000,000 board feet were being negotiated or advertised, with every prospect of early consummation.

TIMBER TRESPASS.

The receipts from timber trespass were \$18,870.20. The greater portion of this amount was received in settlement for damages in trespass cases which occurred some years ago, chiefly in connection with fraudulent land claims in California. The timber trespass occurring on National Forests in recent years is insignificant in amount and value.

TIMBER SETTLEMENT.

The receipts from timber cut in connection with the occupancy or use of National Forest lands were \$17,101.51, as compared with \$2,298.69 in 1916. Receipts from this source are seldom large, but vary widely from year to year as construction work on various projects is stimulated or retarded by general economic conditions.

PROTECTION.

In the calendar year 1916 favorable fire conditions prevailed throughout the greater part of the National Forest regions. The number of fires fought was 5,655, as against 6,324 in 1915. The average damage per fire, \$32.94, was less than 44 per cent of the average for the preceding five years, and the average cost of fire fighting per fire was \$26.55, less than 53 per cent of the average cost for the same five-year period. Although the timbered area burned over was 303,229 acres, or more than double that burned over in 1915, the loss from damage to timber, reproduction, and forage was only \$198,599 as against \$353,389 in 1915. The disparity between the area burned over and the value of the forest resources destroyed was due largely to the fact that of the total timbered area on which the fires occurred 157,964 acres, or 52 per cent of the total area, were in the two National Forests in Arkansas, while the property damage on these two Forests was only \$18,675, or 9 per cent of the whole. In California and New Mexico the burned-over areas reached totals of 15,939 acres and 15,067 acres, respectively. The generally favorable character of the season is indicated by the small areas burned over in the other National Forest States, no single State reaching a total of 10,000 acres. Only 250 of the total number of fires caused losses in excess of \$100.

Of the 5,655 fires extinguished, 849 had their origin on areas outside of the exterior boundaries of the National Forests, and of this number 722, or 85 per cent, were extinguished before reaching the Forest boundaries.

The following table classifies the total number of fires in 1916 according to areas burned over, losses, and causes:

TABLE 5.—*Fires on National Forests, calendar year 1916.*

Extent and cause of fire.	Number of fires.	Percentage of total.
Area burned over:		
Under 0.25 acre.....	2, 634	46. 58
Between 0.25 and 10 acres.....	1, 499	26. 51
10 acres and over; damage under \$100.....	1, 272	22. 49
10 acres and over; damage \$100 to \$1,000.....	193	3. 41
10 acres and over; damage over \$1,000.....	57	1. 01
Total.....	5, 655	100. 00
Cause of fire:		
Railroads.....	541	9. 57
Lightning.....	1, 337	23. 64
Incendiaries.....	708	12. 52
Brush burning.....	481	8. 51
Campers.....	990	17. 50
Lumbering.....	358	6. 33
Unknown.....	1, 019	18. 02
Miscellaneous.....	221	3. 91
Total.....	5, 655	100. 00

In the calendar year 1917 the fire situation was, on the whole, exceptionally favorable until near the end of June. The eastern Forests came through the danger season, which in the South is in the winter and early spring and in the North opens correspondingly later, extending well into or through June in the White Mountains, without serious fires and with conditions on the whole normal or better. In the Southwest, where the main danger is in the spring and early summer, the situation was more favorable than usual on June 1, but grew rapidly worse until early July, when rains brought the fire season to a close. One very large and dangerous fire on the Chiricahua division of the Coronado National Forest, in Arizona, was put under control only after heavy expenditures. In Michigan and Minnesota the spring was very dry and the fire season correspondingly bad. In California a few days of excessive heat about the middle of June brought a sudden emergency and many fires, the worst of which were in the southern part of the State. At the close of the fiscal year the general situation throughout the West was about normal.

The remainder of the summer put the National Forest protective system to the severest test which it has experienced since the great fires of 1910, and made necessary the heaviest emergency expenditures which have been known since that disastrous year. Had it not been for the great advance which has been made in organized fire protection in the interval, there might easily have been a repetition of the widespread losses which were then suffered. The hardest part of the fight against the fires was taken by district 1, embracing Montana and northern Idaho—the same region which suffered most severely in 1910. In Oregon and Washington the danger was not much less, but the fires on the National Forests were less extensive. Late in August the emergency expenditures for fire fighting in district 1 were for a time about \$15,000 a day. Before the fall rains brought the fire season in the Northwest to a close the emergency outlay since the beginning of the current fiscal year had reached a

total of over \$950,000. In California the fire season has not, at the time of submitting this report, yet terminated.

Details regarding the extent of the losses can not yet be given, and belong to the next report; but while the property losses have been considerable they are, in comparison with the risk, remarkably small, and so far as known there was no loss of life. With a period of drouth that extended throughout most of Montana, northern Idaho; Oregon, and Washington, over an average period of more than 90 days, with parching heat and winds of extraordinary violence, the woods of the Northwest were, through the work of the Forest Service and that of the State and private protective organizations, saved from a great catastrophe. The outlay involved in excess of the emergency appropriation of \$150,000 has been paid from funds appropriated for the support of the various activities incident to the operation and improvement of the National Forests. Unless these funds are reimbursed much important work necessary to continued use of the Forests by the public will have to be suspended before the close of the current year. To prevent this a deficiency appropriation of \$700,000 will be required, and will be sought from Congress.

Whenever the responsibility for a forest fire can be fixed, an attempt is made to collect the damages to the United States resulting from the fire. There was received last year in settlement of damages in fire-trespass cases the sum of \$52,513.64. Most of this was paid by a large railroad company whose negligence in causing disastrous fires in 1910 was established in court proceedings and against which a judgment for \$50,000 was secured.

Protection of the National Forests against insect infestation and tree diseases was continued along essentially the same lines as in the past, with the cooperation of the Bureaus of Entomology and Plant Industry. Effective cooperation with private owners was secured in active control measures in some timber, partly in private and partly in Government ownership, threatened by serious insect infestations. In California a study of the insect problem in the yellow-pine region was undertaken in cooperation with the Bureau of Entomology and with private owners. The object of this study is to determine the extent of the infestations and the scale on which control should be undertaken. The California insect attack has brought to the attention of many timber owners the need for protective measures against this important form of menace, and public discussion of the subject has, it is believed, been of material value in pointing out the necessity for better forest sanitation.

REFORESTATION.

Reforestation work on the National Forests was hindered in 1917 by difficulty in securing satisfactory labor and by an unusually late spring. Some areas which it was expected to plant in May or June were covered with snow until the end of the fiscal year. The total acreage planted and sown is therefore less than in 1916. As in previous years, the areas reforested were chiefly old burns of such large size that natural seeding from the side has not occurred. Such areas were reforested in the Douglas-fir region of the Pacific Northwest, in the

white-pine region of northern Idaho and western Montana, in the white-pine and red-pine region in the Lake States, and in the yellow-pine and Douglas-fir region in the Rocky Mountains. Work was also continued in the sandhill region in Nebraska and on a number of watersheds from which municipal supplies of water are drawn.

The average costs of planting and sowing reflect the higher cost of labor and supplies. The average planting cost was \$12.13 per acre, as against \$10.62 in 1916, and the average cost of sowing \$4.69 as against \$4.45.

The acreage planted and sowed is shown by States in Table 6.

TABLE 6.—Planting and sowing on National Forests, by States, 1917.

State.	Area planted.	Area sowed.	Total.	State.	Area planted.	Area sowed.	Total.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>		<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Idaho.....	2,052.75	3.00	2,055.75	New Mexico.....	88.50		88.50
Montana.....	1,771.40		1,771.40	Virginia and West			
Colorado.....	933.57	166.00	1,099.57	Virginia.....	24.00	20.00	44.00
Oregon.....	898.00		898.00	New Hampshire			
Nebraska.....	751.37		751.37	and Maine.....	14.00		14.00
Minnesota.....	380.40		380.40	Florida.....		1.91	1.91
Utah.....	226.51		226.51	Wyoming.....	1.20		1.20
California.....	140.30		140.30	Total.....	7,490.70	190.51	7,681.61
Washington.....	106.00		106.00				
Michigan.....	102.70		102.70				

Table 7 gives the nurseries maintained by the Service, with their locations and the amount of stock on hand July 1, 1917. The stock on hand is approximately the same as in 1916.

TABLE 7.—National Forest nurseries and stock on hand.

Nursery.	Forest.	State.	Seedlings.	Trans-plants.	Total.
Beal.....	Michigan.....	Michigan.....	262,000	51,000	303,000
Beaver Creek.....	Wasatch.....	Utah.....	987,170	377,520	1,364,690
Bessey.....	Nebraska.....	Nebraska.....	5,298,600	1,624,400	6,923,000
Boulder.....	Helena.....	Montana.....	209,500	172,750	382,250
Cass Lake.....	Minnesota.....	Minnesota.....	1,365,000	235,000	1,600,000
Cottonwood.....	Wasatch.....	Utah.....	2,938,000	476,200	3,414,200
Fort Bayard.....	Gila.....	New Mexico.....	186,500	116,400	302,900
Gallinas.....	Santa Fe.....	do.....	175,000	60,000	235,000
Monument.....	Pike.....	Colorado.....	1,935,000	727,900	2,662,900
Monton.....	Nebraska.....	Nebraska.....	1,180,700	346,000	1,526,700
Page Creek.....	Siskiyou.....	Oregon.....	132,000	129,236	261,236
Pilgrims Creek.....	Bhasta.....	California.....	408,500	179,500	588,000
Pocatello.....	Cache.....	Idaho.....	701,600	185,000	886,600
Savenac.....	Lolo.....	Montana.....	3,631,000	2,569,000	11,200,000
Wind River.....	Columbia.....	Washington.....	3,207,000	1,681,500	4,788,500
Three smaller nurseries.....			20,975	20,381	41,356
Total.....			27,623,545	8,850,787	36,474,332

The large amount of seed collected in 1915 made it unnecessary to collect or purchase more than a small quantity in the fall of 1916, when the seed crop was poor on most of the National Forests. The amount collected and purchased and its cost is shown in Table 8.

TABLE 8.—Tree seed collected and purchased.

Method of obtaining seed.	Conifers.		Hardwoods.	
	Clean seed.	Average cost per pound.	Clean seed.	Average cost per pound.
Collected by the Forest Service:	<i>Pounds.</i>		<i>Pounds.</i>	
District 1.....				
District 2.....	3.50	\$1.00	5.00	\$0.22
District 3.....	21.00	5.11		
District 4.....	18.50	1.80		
District 5.....	111.50	.99		
District 6.....	255.00	1.75		
District 7.....				
Total.....	409.50	1.71	5.00	.22
Purchased:				
Native species.....	433.50	1.44	22.00	.30
Exotic species.....	.50	1.20		
Grand total.....	843.50	1.57	27.00	.29

FREE DISTRIBUTION OF PLANTING STOCK.

Under the act of March 4, 1911, 127,550 trees were distributed to 704 settlers in the Kinkaid district in Nebraska. These trees were chiefly jack pine, which has been found most suitable for planting the sandy uplands, and white elm, which does well on the bottom lands. Small amounts of other species were also furnished.

RANGE MANAGEMENT.

The demand for permits to graze live stock on the National Forest ranges continues to increase. The settlement of the public domain brings new applicants for grazing privileges with each succeeding season, while the continued high prices received for meat, wool, and hides are an incentive for the older permittees to endeavor to increase their stock. The winter season of 1916-1917 was the most disastrous the range stockmen of the West have ever known. There have been previous years when local losses were heavier, but never when the losses were so general in every range State. Early snows in the fall of 1916 forced stockmen to begin winter feeding from one to two months earlier than usual. The hay crop for 1916 was in many regions of the West somewhat below normal. The spring of 1917 was from four to six weeks late in every part of the West, the combination of long feeding season and short hay crop resulting in a shortage of hay before the ranges were in condition to receive stock in the spring. Hay, on this account, reached abnormal prices—as high as \$40 a ton being frequently paid. In many instances hay could not be secured at any price, and in some regions the snow on the ranges was so deep that it was impossible to transport the hay to the starving animals. In consequence, the lamb crop for the entire West was considerably below the average, probably from 15 to 20 per cent below, while the losses of the adult stock were serious. Cattle losses were also unusually heavy, and the calf crop considerably below normal.

Early in April, owing to the need to increase the national food supply, instructions were issued to every supervisor to increase the number of stock already authorized by the Secretary for the season of 1917 wherever this was possible without serious danger of over-grazing and over-stocking the range. The supervisors were advised also that in every instance where the conditions made it advisable the ranges should be open for the admission of stock at earlier dates than those established. Under these conditions several hundred thousand additional sheep and cattle were admitted to the Forests.

While the higher ranges in all the National Forests were not available for the stock for from four to six weeks later than usual on account of deep snows, nevertheless after the snow had disappeared the forage conditions were never better, and on June 30, 1917, the National Forest ranges were almost universally in excellent condition and stock of all kinds doing well.

PERMITS.

The number of grazing permits issued and the stock covered by these permits are shown in Table 9:

TABLE 9.—*Grazing permits issued and number of stock grazed under permit, fiscal year 1917.*

State.	Cattle, horses, and swine.				Sheep and goats.		
	Permits issued.	Number of stock grazed.			Permits issued.	Number of stock grazed.	
		Cattle.	Horses.	Swine.		Sheep.	Goats.
Arizona.....	1,504	310,815	7,211	367	129	369,307	4,765
Arkansas.....	47	1,089	5	41			
California.....	2,913	196,002	8,933	857	378	456,325	9,427
Colorado.....	3,841	338,265	9,656		662	917,120	972
Florida.....	17	471		49	3	535	
Georgia.....	46	248	24	22	3	40	2
Idaho.....	4,221	180,148	14,321		837	1,672,218	
Michigan.....	2	13			1	77	
Montana.....	2,780	165,501	16,740		421	774,927	600
Nebraska.....	50	11,220	821				
Nevada.....	468	77,274	4,690		92	395,225	
New Hampshire.....	3	31					
New Mexico.....	1,993	165,256	5,268	648	566	479,817	33,695
North Carolina.....	145	673	31	84	9	111	
Oklahoma.....	67	4,413	274				
Oregon.....	2,385	140,861	9,771	53	535	772,224	478
South Dakota.....	572	29,393	3,232				
Tennessee.....	46	209	4		5	94	
Utah.....	7,592	176,675	11,650	185	1,406	802,068	
Virginia.....	209	1,811	31		10	132	
Washington.....	884	24,871	1,664		170	253,141	
West Virginia.....	3	34					
Wyoming.....	1,168	127,925	4,554		275	692,673	
Total, 1917.....	31,136	1,953,198	98,880	2,306	5,502	7,586,034	49,939
Total, 1916.....	28,052	1,758,764	98,903	2,968	5,276	7,843,205	43,268

Table 9 shows an 11 per cent increase in the number of cattle, but a 3 per cent decrease in the number of sheep. In reality the number of sheep on the Forests for the 1917 grazing season was probably greater than for the 1916 season by more than 200,000. The figures fail to show this because many of the fees for sheep grazed in the

1917 season had not been received and the permits issued when the fiscal year closed. The same condition did not prevail in regard to the cattle and horses, since the grazing season for these classes of stock opened much earlier.

There were 3,084 new permittees for cattle and horses and 226 for sheep and goats. The increase shown in the table of over 11 per cent in cattle, and nearly 11 per cent in the number of permittees of all kinds, was due largely to a more intimate knowledge of the forage growth and the carrying capacity of the ranges through careful reconnaissance, and the desire to increase the production of live stock to meet the food needs of the country. The rapid passing of the public domain to private ownership, coupled with the desire of the stockmen to increase the meat, wool, and hide supply, emphasizes the importance of continuing the study of the Forest ranges.

There were issued 1,666 free grazing permits, allowing the grazing of 69,970 head of cattle, 1,793 head of horses, 414 swine, 451,900 sheep, and 757 goats, in exchange for the use by National Forest permittees of 2,509,154 acres of unfenced private lands within the Forests. This is a reduction as compared with the previous year in the amount of land released and also in the number of stock grazed except for sheep, for which there was an increase of 22,737 head.

Crossing permits numbering 2,176 were issued, allowing 56,954 head of cattle, 1,148 horses, 61 swine, 3,385,429 sheep, and 47,897 goats to be taken across the Forests. The number of permits showed a slight increase, but the number of stock crossing the Forests was reduced, except in the case of goats and horses, the number of which increased materially.

The \$342,309.27 increase in receipts from grazing over the receipts for 1916 was due mainly to an increase in the rates, but largely also to the greater number of stock upon the Forests under temporary emergency permits as a war measure and by the steps taken to relieve the very difficult situation in which the live-stock industry was placed by the bad winter and late spring.

COOPERATION WITH LIVE-STOCK ASSOCIATIONS.

On June 30, 1917, 359 live-stock associations were cooperating with the Forest Service, as compared with 254 the year before. The increase of 41 per cent emphasizes the value of such cooperation to the National Forest live-stock industry.

One of the most satisfactory results of cooperative work has been the establishment and enforcement of special rules on a large number of Forests under which the associations have purchased pure-bred bulls for use by the members of the association. The bulls are the property of the association, and each permittee using the range for which the association is recognized is required to pay his pro rata share of the cost of the animals. Losses, therefore, fall upon the association as a whole. The distribution of the bulls on the ranges is much better, and through the use of better blood the character

and weight of the animals produced will in a few years make very adequate returns on the investment. Moreover, the use of pure-bred bulls, generally of one type, will lead to the fixation of a uniform output of beef animals from the ranges, which will of course result in better prices. The special rules regarding the placing of salt on the ranges by agents of the stock association instead of through individual effort has also greatly improved conditions. The salt is purchased in large quantities, generally by carload lots, and placed upon the ranges usually by contract, which makes both for economy and for much better distribution and more satisfactory conditions both for range and stock than when each permittee handles the salt for his own stock.

The formation of live-stock associations and other cooperation with the Service has materially assisted the grazing supervision of the Forests, and has afforded small owners a more economical means of handling their stock.

FREE USE OF RANGE.

The numbers of live stock allowed free use of the National Forest ranges continue to increase. The regulations allow the free grazing of 10 head of any kind of domestic animals kept for the use of the settler's family. Free grazing for a number of stock belonging to various Indians residing in or adjacent to the National Forests has been continued as a matter of encouragement to self-support. Further withdrawals of areas from grazing in order to protect the sources of water supply for towns and cities in or near the Forests have been made; and in a few of the Forests grazing is either prohibited or restricted upon large areas for the purpose of protecting the game animals. The total area devoted to the above-mentioned purposes is increasing, with corresponding reduction of the area available for grazing under pay permits.

GRAZING IN THE APPALACHIAN REGION.

Grazing conditions upon the eastern purchase areas on which title to the lands has passed to the Federal Government continue to improve, and it is evident that wherever the grazing of live stock on these areas is compatible with the purposes for which they were created National Forests their use for grazing will be of material benefit to the farmers in their vicinity.

DESTRUCTION OF PREDATORY ANIMALS.

The work, which is conducted by the Bureau of Biological Survey in cooperation with the Forest Service, has been continued by the officers of that bureau with gratifying success, and the depredations of predatory animals upon the flocks and herds of the local stockmen has been appreciably decreased. The Biological Survey, besides employing hunters of its own, furnishes traps, ammunition, and poison to forest officers, who devote such time to this work as

their other duties will permit. The predatory animals killed by forest officers totaled 3,027, as against 4,455 the previous year.

CLEARING RANGE OF RODENTS.

The Bureau of Biological Survey has continued to treat areas infested with prairie dogs, ground squirrels, and other range-destroying rodents with excellent results. The National Forest acreage infested with these animals is being decreased rapidly. With the prosecution of the work which the Bureau of Biological Survey is conducting on the public domain in the vicinity of the Forests, danger of reinfestation of the Forest ranges will be greatly lessened.

GAME PRESERVATION.

In last year's report the disadvantages of the present dual jurisdiction of the States and the Nation in the care of the wild life on the National Forests were discussed. Cooperation of the Forest Service and the State authorities in the enforcement of the State game laws is bringing steady improvement in the observance of these laws; but in the making of laws there is no coordination of policies either among the States or between the individual States and the Federal Government. As a rule each State passes its game laws without regard to the effect upon adjoining States or upon National Forest administration. Game preserves are often established which embrace large areas of National Forest lands, entirely without reference to the close relation between live-stock grazing and game propagation and the necessity for adjusting each to the other. Last year 32 new game preserves were established in National Forests in the West. Of these 16 were established in California on recommendations made by the State game officials after consulting with representatives of the Forest Service; but this was an exceptional course. It would be vastly better if the same course were followed generally before game laws are enacted.

Many areas in the Forests though not at present stocked with game are suitable for its propagation and should be used in this way. The Forest Service and the Bureau of Biological Survey have made many transplants of game, particularly elk. Several of the States have also taken up the work to some extent. The closest cooperation between the Federal and State Governments is important to avoid placing game upon areas not suitable for it or where it will conflict with interests that should have preference. The Chamberlain-Hayden bill, which failed of passage in the last Congress, provided for working out a general cooperative plan with the States. It contemplated the establishment of many small game sanctuaries instead of the large game preserves which the States usually create. Some form of legislation, either Federal or State, which will insure a correlation of action in creating game preserves and handling the game animals on National Forests seems desirable, if not absolutely necessary. The voluntary action of North Carolina and Tennessee establishes a method by which these results may be obtained. Action along similar lines by other States would solve the whole problem.

Last spring the Forest Service, in cooperation with the National Park Service, made a recount of the northern herd of elk in the Yellowstone Park in order to verify former counts. This herd in reality comprises three distinct units, known as the Gardiner, Gallatin, and Madison herds. The result showed 17,422 in the Gardiner herd, 1,670 in the Gallatin herd, and 253 in the Madison herd, making a total of 19,345 elk; a smaller number than former counts. The heavy losses which occurred from the severe weather conditions during the winter of 1916-17 undoubtedly account for a large portion of the decrease. This, with the number killed by hunters legally and the number shipped from this herd by the Federal Government and the State for transplanting purposes, explains at least a part of the discrepancy.

The number of elk remaining in this herd is still sufficient, if properly protected from poachers and cared for during severe winters, to restock the area completely and to provide a supply for transplanting.

USE OF THE FORESTS FOR WATER-POWER DEVELOPMENT.

The net total of power permits in force increased by 31, but the average power capacity of all projects under permit decreased, largely through the elimination of two large projects on which construction work was not begun, and of the Hetch Hetchy project of the city of San Francisco, which by a special act of Congress has received an easement making a permit unnecessary. Of the increase in the number of permits 21 took place in the class which covers transmission lines only.

Permits are classified according to the character of the works covered. Permits for transmission lines only are designated transmission-line permits, while those which cover reservoirs, conduits, or power houses, with or without transmission lines, are designated power project permits. Table 11 shows the amount of development authorized under both classes.

TABLE 10.—*Applications for power permits.*

Kind of permit.	Transmission lines only.	Power projects (reservoirs, conduits, power houses).	Total.
For rental permits:			
Preliminary.....		12	12
Final.....	21	13	34
For free permits.....	3	10	13
Total.....	24	35	59

TABLE 11.—*Water-power development under permit, fiscal year 1917.*

Class of permits.	Transmission lines only.			Power projects, (reservoirs, conduits, power houses).		Total number of permits.
	Number of permits.	Length in miles.		Number of permits.	Estimated average output at minimum discharge.	
		Within forest boundaries.	On National-forest land.			
Permits in force at close fiscal year:						
Rental permits—						
Preliminary.....				26	124,795	26
Final.....	128	935.1	670.5	85	603,976	213
Free permits.....	14	181.5	122.0	83	9,679	102
Total.....	142	1,116.6	792.5	199	738,450	311
Construction completed at close fiscal year:						
Rental permits.....	127	934.3	669.7	63	357,262	195
Free permits.....	11	119.8	84.0	63	7,946	79
Total.....	138	1,054.1	753.7	136	365,208	274
Construction incomplete at close fiscal year:						
Rental permits.....	1	.8	.8	9	204,257	10
Free permits.....	1	24.0	15.0	13	1,494	14
Total.....	2	24.8	15.8	22	205,751	24
Construction not started:						
Rental permits.....				34	167,252	34
Free permits.....	2	37.7	23.0	7	239	9
Total.....	2	37.7	23.0	41	167,491	43

Reference has already been made to the decision of the Supreme Court of the United States in the case of the Utah Power & Light Co. v. The United States. This company was occupying and using without permission certain lands of the United States within the Forest reservations for the purpose of generating and distributing electric power. The company claimed that it was entitled to occupy and use Government land without first securing the grant or license from the Secretary of Agriculture that is required by the existing legislation. It further claimed that in occupying and using Government land it had acquired vested rights. It contended also that, except as to land used strictly for governmental purposes, lands owned by the Government within a State are subject to the laws of the State in the same manner as other lands. The decision is especially valuable in that it has determined the scope of the various acts of Congress and their application with respect to rights of way over public land for the generation and distribution of electric power. It establishes that at the present time there is only one act of Congress, namely, that of February 15, 1901 (31 Stat., 790), which permits power developments on National Forest land for generating and distributing power to be used for general commercial purposes.

OTHER SPECIAL USES.

Permits for the occupancy of National Forest lands for various uses, other than water power, issued during the year numbered 6,025, of which 3,560 were charge and 2,465 free. At the close of the year a total of 9,846 charge permits and 11,733 free permits were in effect. The receipts from this source rose from \$83,900 to \$107,530.85, a growth of 28 per cent in a single year. This is largely attributable to the provisions of the act of March 4, 1915, enabling the Secretary of Agriculture to issue permits for the use and occupancy of not to exceed 5 acres of National Forest land to any one person or corporation for a period not exceeding 30 years. Already it has been demonstrated that this legislation was just what was needed, and as a result of it the National Forests are performing a larger public service.

The use of some of the National Forests for recreation purposes is growing to such importance as to be one of the major activities. Upon the Angeles National Forest permits for 814 residences, 26 hotels, and 28 summer resorts were in force at the end of the fiscal year. It is believed that the use of the National Forests along this line, as shown by the foregoing figures, represents only a promising beginning of the development which is to follow.

ROADS, TRAILS, AND OTHER IMPROVEMENTS.

In addition to the \$400,000 provided by the agricultural appropriation act for the construction and maintenance of permanent improvements, \$429,305.77 was available for roads and trails within the Forest boundaries from the 10 per cent fund derived from receipts. This comprised \$278,216.56 derived from the 1916 receipts and an unexpended balance from previous years of \$151,089.21. As in previous years, cooperative projects were carried on with funds contributed by the Forest Service and by the local communities.

The following tabulation shows the number of miles of public roads constructed up to December 31, 1916, from the 10 per cent appropriation and other funds.

TABLE 12.—Road construction and improvement¹—10 per cent and cooperative funds, by States.

State.	Total mileage to Dec. 31, 1916.	Total mileage in 1916.	State.	Total mileage to Dec. 31, 1916.	Total mileage in 1916.
	<i>Miles.</i>	<i>Miles.</i>		<i>Miles.</i>	<i>Miles.</i>
Alaska.....	10.74	2.53	Nebraska.....	4.80	.....
Arizona.....	120.25	15.50	Nevada.....	123.25	0.25
Arkansas.....	17.50	3.00	New Mexico.....	65.25	1.75
California.....	216.98	18.00	Oklahoma.....	17.50	.....
Colorado.....	108.70	2.50	Oregon.....	143.41	3.20
Florida.....	10.00	.....	South Dakota.....	13.10	.....
Idaho.....	135.98	23.92	Utah.....	152.35	20.30
Kansas.....	3.40	.....	Washington.....	80.56	10.94
Michigan.....	22.20	22.20	Wyoming.....	74.15	4.80
Minnesota.....	2.00	2.00			
Montana.....	180.75	7.55	Grand total.....	1,514.67	147.44

¹ Does not include bridge or maintenance work.

The cost of repairs and necessary replacement of permanent improvements on the Forests is now about 40 per cent of the annual appropriation, amounting in 1917 to approximately \$160,000. Considering the exposed situation of these lines of communication and other Forest improvements, this rate of depreciation, between 2 and 3 per cent of their total value, is surprisingly small. It will be materially increased during the ensuing year by the rapidly advancing costs of materials and labor.

The new construction comprised 130 miles of roads, 1,153 miles of trails, 1,414 miles of telephone lines, 26 miles of fire lines, 39 lookout structures, 40 bridges, 148 miles of fences, 320 dwellings, barns, and other buildings, 8 corrals, and 190 water improvements. The above figures include 65 miles of roads, 172 miles of trails, 78 miles of telephone lines, 33 miles of stock fences, 20 miles of fire lines, 5 bridges, 4 lookout stations, 1 dwelling, 31 water improvements, and 4 corrals built in cooperation with communities, associations, and individuals.

The value of all improvements on the National Forests at the close of the year constructed from funds derived from congressional appropriations and the contributions of cooperators is estimated at \$6,992,599. Of this amount \$5,071,875, or 72.5 per cent, represents works of communication and protection; \$1,715,836, or 24.5 per cent, improvements used in administration, and \$204,868, or 3 per cent, range improvements. The lines of communication within the Forests constructed by or under the direction of the Forest Service now total 2,922 miles of roads, 25,193 miles of trails, and 23,118 miles of telephone lines.

ROAD CONSTRUCTION UNDER THE FEDERAL-AID ROAD ACT.

Section 8 of the act of June 11, 1916, commonly known as the Federal-aid road act, appropriated \$10,000,000 for roads and trails within or partly within the National Forests when necessary for the use and development of resources upon which communities in and near the Forests are dependent. Under the terms of the law the work must be done under cooperative agreement between the Secretary of Agriculture and a State, Territory, or county, and the expenditure must not exceed 10 per cent of the value of the National Forest timber and forage resources within the respective counties where the roads or trails will be built.

This law opened the way for undertaking road development greatly needed by the public. On September 1, 1916, regulations providing for the carrying out of section 8 of the Federal-aid road act were approved by the Secretary of Agriculture. They required that applications from States and counties wishing to avail themselves of its provisions should be filed with the district forester within whose district the project is located, after having been referred to the State highway department for recommendation. Applications for the fiscal year 1917 were received up to October 1, 1916, and for the fiscal year 1918 up to April 30, 1917. A total of 143 applications was filed. Authorization was given by the Secretary for entering into negotiations for the preparation of cooperative agreements with the applicants for 43 projects. Various causes occasioned considerable delay

in the execution of the cooperative agreements. Several are still pending, but agreements are now in effect for projects as follows: Arizona 1, California 2, Colorado 3, Idaho 1, Montana 1, and Wyoming 1.

Under an agreement with the Office of Public Roads and Rural Engineering the survey and construction of all National Forest projects approved under the section 8 appropriation is carried on by that office. Unless otherwise provided in the cooperative agreement, it also supervises the maintenance of such roads. The regulations provide that roads constructed by the local authority under cooperative agreement with the Secretary of Agriculture in return for the use of section 8 money on National Forest roads shall be inspected by the Office of Public Roads during construction and maintenance. The plans and specifications for such roads must be acceptable to the Office of Public Roads and the Forest Service.

Section 8 of the Federal-aid road act made available until expended \$1,000,000 for the fiscal year 1917, and the same amount for the nine succeeding fiscal years. Under the regulations 90 per cent of each annual appropriation is apportioned to the States as follows: One-half in the ratio that the aggregate area of the lands of the United States in the National Forests in each State bears to the total land area of such State and one-half in the ratio that the estimated value of timber and forage resources of the National Forests in such State bears to the total value of the timber and forage resources of the National Forests of all the States. It is provided, however, that in such apportionment the States of Florida, Michigan, Minnesota, Nebraska, North Dakota, and Oklahoma shall be considered as a unit of apportionment and the States within which lands have been acquired by the United States under the provisions of the act of Congress of March 1, 1911 (36 Stat., 961), commonly called the Weeks law, will also be taken as a unit of apportionment. The remaining 10 per cent of each annual appropriation is withheld as a special fund from which, as directed by the Secretary, the apportionment to any State as above provided may be increased, and from which there shall be paid such amounts as the Secretary finds necessary for the general administration of the provisions of the act.

Unfortunately little construction work can be expected during the calendar year 1917. For only a few of the approved projects had satisfactory location surveys been made prior to this year. Unexpected difficulty was met in organizing survey parties, owing to the scarcity of experienced engineers due to the large number enrolled in training camps or enlisted in the national service. Several surveys are now under way, and it is hoped that when the next construction season opens active construction can be promptly started on a considerable scale. It is feared, however, that progress will be delayed by the difficulty in obtaining both labor and materials. The cost of any work done during the present emergency will greatly exceed that which would have been met two years ago, but while this may make it advisable to defer construction on some projects, the necessity of some means of bringing agricultural, mineral, timber, and other products to the markets is so great in the present emer-

gency that construction of other projects will often be warranted regardless of cost.

The amount appropriated by section 8 of the Federal-aid roads act is supplemental to the so-called 10 per cent fund derived from receipts, which must be spent entirely within the National Forests. The two funds together will make available annually approximately \$1,300,000 of Federal money for the survey, construction, and maintenance of roads and trails in and near the National Forests. This is materially increased through cooperative funds made available by the States, counties, associations, and individuals. In handling the road and trail work the funds obtained from the appropriation made under section 8 of the Federal-aid roads act and those derived from the 10 per cent item will be virtually combined to carry out a unified program. The Federal funds available for expenditure in each State from both sources are shown below:

TABLE 13.—Amounts expendable for roads and trails, fiscal years 1917 and 1918.

State.	Fiscal year 1917.			Fiscal year 1918.		
	From 10 per cent item.	From Federal-aid roads act.	Total.	From 10 per cent item.	From Federal-aid roads act.	Total.
Alaska.....	\$6,008.32	\$46,280.00	\$52,288.32	\$6,671.85	\$46,354.00	\$53,025.85
Arizona.....	25,608.89	59,795.00	85,404.89	32,414.69	58,604.00	91,018.69
Arkansas.....	4,513.55	11,294.00	15,807.55	5,109.07	9,803.00	14,912.07
California.....	82,019.91	140,763.00	172,782.91	43,593.02	140,988.00	184,581.02
Colorado.....	25,598.03	62,335.00	87,933.03	30,637.97	62,575.00	93,212.97
Idaho.....	34,958.32	108,010.00	142,968.32	36,988.22	108,730.00	145,718.22
Kansas.....	1.91		1.91			
Montana.....	35,940.69	69,901.00	105,841.69	46,648.61	70,042.00	116,690.61
Nevada.....	7,038.86	19,195.00	26,233.86	7,902.65	19,296.00	27,198.65
New Mexico.....	14,204.53	42,622.00	56,826.53	23,402.80	42,495.00	65,897.80
Oregon.....	30,811.69	127,794.00	158,605.69	39,472.47	128,111.00	167,583.47
South Dakota.....	6,177.03	8,115.00	14,292.03	6,383.93	8,092.00	14,475.93
Utah.....	19,353.24	40,982.00	60,335.24	20,681.63	41,167.00	61,848.63
Washington.....	14,881.96	91,739.00	106,620.96	19,782.13	91,944.00	111,726.13
Wyoming.....	15,130.83	40,566.00	55,696.83	14,297.91	40,684.00	54,981.91
Florida.....	1,519.61			1,000.60		
Michigan.....	101.62			13.88		
Minnesota.....	2,304.41	9,552.00	14,557.47	909.99	9,995.00	13,342.26
Nebraska.....	654.70			807.63		
North Dakota.....	31.62			7.04		
Oklahoma.....	394.11			608.12		
Georgia.....	37.00			42.34		
New Hampshire.....	192.74			551.74		
North Carolina.....	178.42			478.22		
South Carolina.....		21,057.00	22,018.33	1.46	21,120.00	23,335.40
Tennessee.....	114.97			167.21		
Virginia.....	414.91			807.62		
West Virginia.....	23.29			166.81		
Total.....	278,216.56	900,000.00	1,178,216.56	339,549.61	900,000.00	1,239,549.61

SCHOOL, ROAD, AND TRAIL MONEY FOR STATES FROM RECEIPTS FUND.

In addition to the sums available for expenditure by the Secretary of Agriculture 25 per cent of the National Forest receipts is paid to the States for the benefit of the county roads and schools. The amounts available from the receipts for the fiscal years 1916 and 1917 are shown in Table 14.

TABLE 14.—Amounts available for States from Forest receipts.

State.	School and road mon- eys payable to States.		State.	School and road mon- eys payable to States.	
	Paid from receipts of fiscal year 1916.	Payable from receipts of fiscal year 1917.		Paid from receipts of fiscal year 1916.	Payable from receipts of fiscal year 1917.
Alaska.....	\$15,023.31	\$16,679.61	North Carolina.....	\$446.04	\$1,195.53
Arizona.....	64,024.72	123,881.52	North Dakota.....	79.06	17.60
Arkansas.....	11,283.87	12,772.68	Oklahoma.....	985.29	1,520.30
California.....	80,049.75	108,982.56	Oregon.....	77,029.23	96,681.18
Colorado.....	63,995.06	76,594.93	Porto Rico.....		
Florida.....	3,799.02	2,501.51	South Carolina.....		3.65
Georgia.....	92.50	2,105.85	South Dakota.....	15,442.59	15,959.82
Idaho.....	87,395.79	92,470.55	Tennessee.....	287.43	418.03
Kansas.....	4.78		Utah.....	48,383.09	51,704.07
Michigan.....	252.55	34.69	Virginia.....	1,037.28	2,019.06
Minnesota.....	5,761.04	5,761.04	Washington.....	37,204.90	49,445.34
Montana.....	89,851.72	116,621.52	West Virginia.....	58.22	417.02
Nebraska.....	1,636.76	2,019.07	Wyoming.....	37,827.07	35,744.77
Nevada.....	17,597.15	19,756.64			
New Hampshire.....	481.85	1,379.34	Total.....	695,541.40	910,406.37
New Mexico.....	35,511.33	77,194.56			

Included in the above statement are additional shares of National Forest receipts payable to the States of Arizona and New Mexico for their school funds on account of school lands within National Forests, as follows: To Arizona, paid from the receipts for the fiscal year 1916, \$31,046.12, and payable from the receipts for the fiscal year 1917, \$42,844.80; to New Mexico, paid from receipts for the fiscal year 1916, \$10,329, and payable from the receipts for the fiscal year 1917, \$18,687.56.

EXCHANGE OF LANDS.

Field work in connection with the consolidation of State lands within the National Forests of Washington progressed very satisfactorily. All the base lands have been examined and appraised, and the field parties were at the close of the year at work on the selection areas. A tentative basis of exchange was agreed upon between the Forest Service and the State of Washington which is clearly of substantial advantage to all parties in interest. It is believed that the work will be completed within the limit of the funds made available by the appropriation act of March 4, 1915. The final consummation of the exchange and consolidation of State lands agreed to with the States of South Dakota, Idaho, and Montana is well under way. What were previously believed to be legal obstacles were removed shortly after the first of the year by an opinion rendered by the Interior Department, holding that it already had sufficient legal authority to consummate the pending exchanges. This opinion was borne out by a decision of the Supreme Court of the United States rendered March 26, 1917, in the case of the State of California, plaintiff in error, *v. Deseret Water, Oil & Irrigation Co.* Title to lands in the selection areas is rapidly being transferred to the States, particularly in Idaho and South Dakota. In Montana further action awaits the completion of necessary surveys.

A number of small exchanges were effected with private owners of land within the National Forests under special acts of Congress. General legislation enabling the Forest Service to make exchanges and consolidations based upon equal value, where such exchanges would be in the public interest, is exceedingly desirable.

ACQUISITION OF LANDS.

On recommendation of the Forest Service, the National Forest Reservation Commission approved for purchase during the year, under the act of March 1, 1911 (36 Stat., 961), 175,463 acres in the southern Appalachians and White Mountains. The total approved and being acquired is now 1,455,563 acres, of which 947,197.50 acres have been acquired. On 195,848.62 acres condemnation proceedings are pending. The remainder awaits the completion of survey or title examination. These lands are being placed under administration and their resources developed as rapidly as they are acquired.

For the continuation of the purchase policy during the fiscal year 1918, and until expended, \$2,000,000 is still available.

COOPERATION WITH STATES.

The past year was the seventh in which cooperation has been offered the States in protecting the forested watersheds of navigable streams from fire. To secure such cooperation a State must have provided by law for a system of forest fire protection and must expend in the same year at least as much as the Federal Government. The appropriation of \$100,000 was apportioned among 21 States, to be used chiefly for the hire of men to patrol the woods.

The allotments for the calendar year 1917 and expenditures, both Federal and State, for the fiscal year ended June 30, 1917, are shown in the following table:

TABLE 15.—*Allotments of Federal appropriation for protecting forested watersheds of navigable streams from fire, with Federal and State expenditures.*

State.	Allotments, calendar year 1917.	Expenditures, fiscal year 1917.		State.	Allotments, calendar year 1917.	Expenditures, fiscal year 1917.	
		Federal.	State.			Federal.	State.
Maine.....	\$8,000	\$6,910.01	\$49,398.11	Wisconsin.....	\$4,500	\$3,957.17	\$17,290.66
New Hampshire.....	6,500	5,823.80	21,135.66	Minnesota.....	8,000	8,474.26	57,841.63
Vermont.....	2,500	1,502.74	1,731.55	South Dakota.....	450	359.50	970.65
Massachusetts.....	2,500	2,869.13	29,886.84	Montana.....	3,500	3,460.05	3,685.09
Connecticut.....	2,000	640.00	4,579.30	Idaho.....	5,500	4,733.08	13,609.96
New York.....	8,000	6,172.80	95,812.99	Washington.....	8,000	8,704.27	32,463.36
New Jersey.....	2,000	1,636.73	15,422.86	Oregon.....	8,000	6,981.74	23,821.10
Maryland.....	2,000	3,014.74	4,948.13	Administration and inspection.....	5,000	4,925.03	.....
Virginia.....	4,000	3,840.60	5,247.01	Unallotted balance.....	650	.....	.....
West Virginia.....	4,500	5,385.50	8,567.33	Total.....	100,000	90,580.14	435,328.11
North Carolina.....	2,000	449.00	1,120.06	Unexpended balance.....	.....	9,419.86	.....
Kentucky.....	4,000	2,737.53	8,633.06				
Texas.....	3,900	3,806.56	3,989.34				
Michigan.....	4,500	4,197.00	35,173.48				

This work has resulted in a very large amount of forest protection not only by States but also by private owners, whose cooperation likewise is sought. Expenditures by private owners probably exceed those by the States and Government combined.

The progress of this cooperation since it was started in 1911 is shown in the following table:

TABLE 16.—*Cooperation with States in fire protection, 1911–1917.*

Calendar year.	Amount of appropriation.	Number of cooperating States.	Estimated area protected.	Number of Federal patrolmen employed.	Total Federal expenditure.
			Million acres.		
1911.....	¹ \$200,000	11	7	200	\$38,793.55
1912.....		12	8	225	50,605.93
1913.....		15	10	250	85,991.19
1914.....	² 75,000	18	12	300	83,870.70
1915.....	³ 100,000	20	13	300	⁴ 69,908.82
1916.....	³ 100,000	21	14½	360	87,975.98
1917.....	³ 100,000	21	14½	360	⁴ 90,000.00

¹ At first available until expended; subsequently made available until June 30, 1915.

² Federal fiscal year ended June 30.

³ Decrease as compared with 1913, 1914, 1916, and 1917 chiefly due to unusually wet season.

⁴ Estimated.

The collecting of statistics on forest-fire losses was continued. Forty States sent in returns. With these as a basis it is estimated for the whole country that in the calendar year 1916 there were approximately 38,000 fires, which burned over an area of about 12,700,000 acres and caused a financial loss in timber, young tree growth, and improvements of about \$10,500,000.

The increasing number of requests from State legislatures and private agencies in the Southeast for assistance in the drafting of forestry bills show that forest fires in that region are beginning to be recognized as a real menace which can best be reduced by the States through the adoption of a progressive forest policy. With its favorable climate and long growing season there is scarcely any part of the United States where tree growth is more rapid or which is better adapted to the practice of forestry, and certainly there is none in greater need of forest conservation. The southeastern States which received assistance of this character included West Virginia, North Carolina, Tennessee, Florida, Alabama, Mississippi, Arkansas, and Texas. Similar assistance was given also to California, Illinois, Maine, Michigan, Minnesota, and Vermont. A representative of the Forest Service appeared before the Florida Legislature, on request, to give information concerning a forestry bill and also attended meetings of timberland owners and State forestry officials in Virginia, North Carolina, and Wisconsin to cooperate in the organizing of associations of such owners for protection against forest fires.

Classified compilations of the forestry laws of Connecticut, Massachusetts, New Hampshire, and Ohio were prepared and published, bringing the number up to 20, which includes, besides the above, Idaho, Illinois, Indiana, Louisiana, Maryland, Minnesota, Missouri, Montana, New Jersey, North Carolina, Oregon, Texas, Washington, Virginia, Wisconsin, and Wyoming. In addition to the broad general classification previously used in these compilations a close analysis of the laws in detail was made, which so brings all related matter together as to show the activities of the various officials and gov-

erning bodies as they bear upon administrative work, fire protection, public forests, and taxation. As now prepared, these compilations are practically a codification of the forestry laws of the several States.

RESEARCH.

NATIONAL FOREST INVESTIGATIONS.

The investigative work on the National Forests comprised reforestation and fire studies, general economic studies, and investigations relating to management and forest growth. It followed in the main plans which have been developed through a number of years. The tendency has been steadily toward broader study of the basic problems of forestry, which require long-time investigations, though not to the exclusion of studies to meet immediate practical needs.

Through a two-month detail to the Washington office last winter of the men in charge of National Forest research work the entire research program, its aims, methods, and organization, and particularly its relation to the administrative or practical side of forestry, was carefully canvassed. The result was a better correlation of the work of the different research units and a better definition of the main problems and special difficulties presented in each district.

It was decided to discontinue, temporarily at least, the two California experiment stations—Feather River and Converse—and to concentrate the work at the other stations. With the funds available the Forest Service had to choose between inadequate support for all the stations (though all are needed) and concentration on the more important problems at fewer stations.

Progress on the comprehensive fire-protection study initiated last year consisted largely in the accumulation and analysis of data, with the outlining of essential principles for further study. The purpose is to obtain a basis for effective distribution of fire-protective funds and the development of intensive protection where the danger is the greatest. Necessarily, this work involves an exhaustive study of both office data and widely scattered field conditions.

A study of the culled and cut-over hardwood lands in the southern Appalachians produced plans for the management of certain National Forest areas.

One of the economic studies made last year concerned the relation of forest utilization to community development in the Pacific Northwest and northern Lake States. The lumber "camp" is the natural result of a nomadic lumber industry. As the forests of any region become permanent sources of timber supply they become capable of supporting a more stable population. Where the forest is the main resource the development of permanent industrial communities as sources of labor supply is obviously desirable. In regions where the land, though originally timbered, will be put to its best use through clearing for agriculture, it is desirable that forest utilization should contribute as largely as it may to the upbuilding of organized agricultural communities. To learn both the present actual conditions and the possibility of bringing about improved conditions the study was undertaken.

Range reconnaissance resulted in the examination and mapping of about 1,100,000 acres, and brought the total area of range thus

covered to 12,288,885 acres. The data gathered are applied in more intensive grazing management. With the beginning of the 1917 field season the plans for range reconnaissance were changed to meet the situation created in the National Forest live-stock industry by the severe winter, increased agricultural settlement, and the war. All available men of sufficient experience were assigned to extensive reconnaissance, with a view to covering as many as possible of the ranges before permits are issued for the 1918 grazing season. The information will aid in increasing the number of live stock on the ranges to the maximum possible without excessive damage. Men of less experience were released for military service. This change in plans to meet emergency conditions will curtail the intensive range classification, but will make possible large temporary increases in stock without jeopardizing the permanent welfare of the range, forests, and watersheds.

Continued experiments on a small scale in seeding range to cultivated forage plants gave results which are chiefly negative, but are important in answering calls for information and preventing outlays on useless range-improvement projects. Studies in natural revegetation of depleted and partly depleted range lands were continued by demonstration tests in range management. Light grazing during the growing period for three years has brought excellent recuperation of approximately 47,000 acres of grama-grass range on the Jornada Range Reserve. On high mountain lands of the Manti Forest it was found that erosion and decrease in soil fertility following range depletion materially lengthen the period necessary for revegetation. The data secured afford further explanation of why certain ranges recuperate rapidly under proper care and others require years before marked improvement takes place. These results are important additions to our fundamental information relating to range management and improvement.

The study of the plants which make up the forage crop on the National Forest ranges was continued and steady progress is being made by all forest officers in acquiring essential knowledge of the range forage crop, both valuable forage plants and poisonous plants. Approximately 4,000 specimens, including a number of new species, were collected, identified, and notes furnished to the collectors. Notes of value for distribution are now available for about 2,500 species of National Forest range plants.

Reports dealing with grazing management on yellow-pine forests of the Southwest, yellow-pine forests of the Northwest, and aspen forests were completed, and one publication on grazing in coniferous forests of the Pacific slope is under way, forming the last in a series on this important phase of grazing investigations. The study of goat ranges and the management of goats on National Forest ranges was continued and extended. Its results are already bringing about an improvement in the handling of goats on the range and a better understanding between goat permittees and forest officers.

The study of grazing management on alpine lands brought out the hitherto unrecognized importance of erosion in its earlier and less severe stages, and of leaching, as a cause of range degeneration through the loss of soil fertility. The results emphasize the neces-

sity of immediate steps to revegetate such lands when vegetation has been so reduced that erosion has begun.

Investigations in California and Oregon to determine the effect of burning over brush areas upon the value of these areas for grazing were continued.

In the study of methods of handling cattle made at the Jornada Range Reserve, a calf crop fully 10 per cent above the average of the locality was saved from a breeding herd held on a fenced range under improved methods and given a small amount of supplemental feeding; while from another herd fed an average of 50 pounds of cottonseed cake per head and given still better care, the saving exceeded the average by more than 20 per cent. Loss from blackleg, straying, and starvation was kept down to only a little over 1½ per cent from the entire herd of 4,500 head, including stock of all ages. The average losses reported by stockmen in New Mexico in connection with the meat investigation were: Calves to 12 months of age, 10.6 per cent; yearlings, 5.6 per cent; and stock 2 years old and over, 5.8 per cent. These results, if confirmed in subsequent years, should stimulate more feeding to supplement range forage, better care of range to prevent overstocking and starvation of stock, greater effort to prevent loss from disease, and segregation and special care of breeding stock to increase the calf crop.

The marked advantages of the bedding-out system of handling sheep was further demonstrated through tests on Utah, Montana, and California forests. Further data were secured on lambing sheep under range conditions, and on the carrying capacity of sheep and cattle ranges. Advance was made in methods of salting cattle and in showing the value of well-distributed watering places.

Demonstration tests of tall larkspur eradication were undertaken in cooperation with stockmen on the Stanislaus, Durango, Fishlake, Sevier, Palisade, Minidoka, Lemhi, and Weiser Forests. In every case losses from poisoning were reduced to an extent which more than justified the cost. Minor investigations were started to work out methods of getting rid of other poisonous plants, but practical application of results has not yet been attempted.

For the grazing season of 1917 investigations were largely discontinued, except at the Jornada Range Reserve and the Utah Experiment Station, where they were greatly curtailed; and all available qualified men were assigned to the emergency campaign to increase live-stock production.

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OTHER INVESTIGATIONS.

STUDY OF THE LUMBER INDUSTRY.

The study of the lumber industry begun in 1914, the scope of which, and some of the most important conclusions of which, have been outlined in previous reports, was continued in cooperation with the Federal Trade Commission and the Bureau of Foreign and Domestic Commerce. The summary section of the report was issued and four additional sections were completed and sent to the printer. Substantial progress was made upon most of the remaining seven sections, although the date of completion of all has been materially delayed by war conditions and demands.

SILVICULTURAL AND DENDROLOGICAL STUDIES.

Field study of the eastern oaks secured much new information on this extremely important group of trees. At the close of the year the study was under way in Arkansas, Louisiana, and Mississippi.

Farm woodlot market studies were completed for Georgia, South Carolina, and Maine, and begun in North Carolina. Such studies have now been completed in 11 Eastern States. In connection with the North Carolina study a special forest survey is being made of two Piedmont counties, in cooperation with the State.

The field work and the principal tabulation of the data on the economic survey of farm woodlots in the eastern United States in cooperation with the Office of Farm Management were finished. Sixteen counties in 14 States, representing all types and conditions of woodland and farms in the North, South, and Middle West were covered. The field data comprise records from 1,000 farms and cover 178,000 acres of farm land, valued at \$13,500,000. Through cooperative agreements with the States Relations Service, foresters were detailed to the Offices of Extension Work in the North and West and Extension Work in the South, to assist farm woodlot owners by demonstrating the best methods of handling farm woodlands, marketing products, and planting trees for production or for protection of crops and buildings. The work will be largely cooperative with the extension departments of State agricultural colleges and with State foresters.

Late in the year methods of increasing the use of wood for fuel in place of coal as a war emergency measure were made a subject of study. Reduction of the pressure on transportation facilities is one of the objects sought. A larger prospective use of fuel wood from farm woodlands creates a need for instruction of the owners in such matters as thinning and marketing. Rightly handled, increased utilization may be secured without reducing the productive capacity of the woodlands and with improvement of their condition.

As a part of the study of the forest regions of the United States, a map showing natural forest units was prepared for publication by the Office of Farm Management in the Agricultural Atlas series.

Fifteen thousand tree measurements were worked up, and 26 volume, 3 yield, 6 growth, 5 form, and 25 miscellaneous tables were prepared. About 2,200 range notes were added to the files, 600 identifications made, and 215 distribution maps revised. Forest maps were prepared of Panama and Cuba, and additional data compiled on the forest resources of Mexico and Central and South America.

In the dendrological study of forest trees of the United States, hitherto unpublished data on miscellaneous conifers of the Rocky Mountain region, gathered in the field work of many past years, were assembled and prepared for publication as another volume in the series under way, which has now covered all the trees of the Pacific coast and all the conifers of the Rocky Mountains. Under a cooperative agreement with the Letchworth Park Forest and Arboretum, at Letchworth Park, Wyoming County, N. Y., the dendrologist of the Forest Service continued to give advice regarding the work in progress there. The plantations made during the year at Letchworth Park comprised various mixtures of 150,000 native pines, spruces, and cedars in forest blocks, while 110 seed beds were sown with some 80

species of European, Japanese, and American forest trees. The study of the nomenclature and the collection of dendrological data were continued. The dendrologist also served throughout the year on the Federal Horticultural Board. One of the important matters before this board has been to devise and put into effect measures for the control of the very dangerous white-pine blister rust, which if not held in check threatens to cause enormous damage to the white-pine forest growths of the West as well as of the East and the Lake States.

STUDIES IN FOREST PRODUCTS.

Utilization of National Forest timber.—Mill scale and depreciation studies were continued to secure a better basis for appraisals of National Forest timber. Detailed studies of markets were also continued. Structural tests on Alaskan species to ascertain their suitability for mining purposes proved several to be equal to or better than a number of species commonly used in the Rocky Mountains. A safe method of artificially drying Sitka spruce for use in airplanes was developed. Work was continued on Rocky Mountain Douglas fir to find some means for satisfactory preservative treatment. The administrative organization was assisted in stimulating interest in pulp chances on National Forests. Kiln-drying tests were made on Douglas fir and western yellow pine, and further efforts made to prevent brown stain in the drying of sugar pine. Several additional National Forest species were shown to be suitable for No. 1 kraft paper.

Forest Products Laboratory.—In addition to the cooperation with various governmental agencies and manufacturers of war orders on war problems already discussed, there was effective cooperation with various cities and societies to bring about the best methods of preservative treatment for wood-block pavements; with furniture and wood-ware manufacturers, railroads, and lumber manufacturers in methods of kiln drying, and in the design of dry kilns; as in the past, with numerous railroad, telephone, and telegraph companies, in the preservative treatment of ties and poles; with factory and insurance companies in the development of preservatives to prevent decay in cotton mills; and with pulp and paper companies on various questions of pulp and paper making. Cooperation progressed to the stage of commercial demonstrations in the use of waste hemlock bark for roofing and various paper products; in the treatment of timber to prevent sap stain; in the kiln-drying of southern pine; and in the production of ethyl alcohol from wood waste, in which it is possible by the improved process developed in the laboratory to reduce operating expenses by \$300 per day. At the national tractor exhibit for 1916 at Madison, Wis., an ordinary farm engine was operated on ethyl alcohol made from wood waste. Specially designed engines will produce as much work per pound of alcohol as per pound of gasoline.

Approximately 10,000 additional tests of mechanical properties of various species of wood were made, and a report was completed analyzing the approximately 130,000 tests made up to the present. These data make possible scientific grading rules for structural timber, such as those already perfected for southern pine and under development for Douglas fir and hemlock, and, in general, furnish a

scientific basis for the use of wood. Over 500 tests were made from Sitka spruce, white oak, and yellow birch to determine the influence of drying and steaming on strength, with particular reference to use in airplanes. Tests upon beams to determine the effect of continuous loading were continued.

Kiln-drying tests previous to the entrance of the United States into the war continued along the same lines as in the past. Encouraging tests on structural sizes of Douglas fir show the possibility of kiln drying without appreciable loss of strength. A method was perfected under which hemlock ship-lap can be dried to shipping condition with practically no degrade in 40 to 48 hours, and 2-inch plank in from 4 to 6 days. Douglas fir and red and white fir were also dried to practically a perfect condition in 48 hours. The time for drying maple last blocks was reduced from 21 to 2 months, and losses reduced from an average of about 15 per cent to 6 per cent. Green basswood was satisfactorily dried in 2-inch thicknesses in 13 days and 1-inch thicknesses in 9 days. Dogwood sticks and ironwood blocks were dried in comparatively short periods without checking or honey-combing. Work was largely completed on spruce and ash for airplanes, the problem being to dry the material in the minimum time without loss of strength and toughness as compared with air-dried stock.

In the wood-preservative work the most striking development of the year was the initiation of tests to determine the best preservative treatment for construction wood in cotton mills, where conditions are extremely favorable to decay. With particular reference to the textile-mill region of the East, practical aspects of timber-decay problems in buildings were studied in cooperation with the Bureau of Plant Industry. Tests were continued, with some success, to devise methods for the satisfactory impregnation of Douglas fir with wood preservatives. White birch, in a test wood pavement in Minneapolis, made a remarkable showing for 10 years and proved fully equal to longleaf pine. A report prepared for publication points out correct methods of construction for wood paving and thus makes it possible to avoid the difficulties which have been experienced in the past. A report was completed covering the results of 10 years' tests of approximately 12 wood preservatives on ties of 61 species laid in test tracks in 33 railroads. Continuing investigations on treated silo timber corroborate preliminary tests that creosote does not appreciably injure silage. Cooperation with the Bureau of Fisheries brought out the relationship between the boiling point and toxicity of preservatives against marine borers, and should prove of value in the development of a special marine creosote for use in heavily infested water. Additional experiments were begun to find a preventive of sap stain in timber, deterioration from which causes a loss amounting to several millions of dollars annually. In cooperation with the Bureau of Plant Industry, the direct relation between toxicity and volatility of coal-tar creosotes was established, so that it is now possible to determine toxicity from distillation curves, as in the case of mixtures of coal-tar creosote and gas oils and of creosotes and crude oils. With especial reference to airplanes, the efficiency of glues and the best technique for their use was studied, and work on treatments and coatings to reduce or prevent the absorption of moisture and consequent shrinkage and expansion continued.

Makers of pyrometers are now actively advertising the method of controlled distillation developed by the laboratory. It is believed that at least 50 per cent of the plants are attempting to use this method. Increased production is important because of the demand for the products in munitions making. One year's experiments indicate that the yield of naval stores can be increased by 30 per cent or more by making two narrow rather than one broad streak per week, as in commercial practice, and that net returns per crop can be increased by about \$450. The same trees are being chipped for the second year to determine if the yield will be maintained. Double chipping should be especially applicable in the case of lumber companies which desire to obtain maximum yields for a short period prior to cutting.

In the chemical survey of woods the mannan content was determined for 22 softwoods and 6 hardwoods. This is important, because of its relation to the yield of ethyl alcohol.

Further study of the utilization of various waste barks for the manufacture of pulp and paper products included that of 8 species. Observations over a period of six months failed to show any marked signs of depreciation in paper and board made on a furnish of hemlock tanbark stored under ordinary conditions. Cooperative work is under way to determine the commercial practicability of using the various barks in a number of paper products. Tests under the soda process were continued for 13 species. Bleaching tests were also made on a number of these pulps. Similar tests, by the sulphite process, which supplies a part of the material used in news print, were made on 12 species, and some work was done to devise a method which will permit the sulphite pulping of resinous woods. A study of fundamental variables in the sulphite process, under way for a number of years, was completed. Tests under the sulphate process were continued in 18 species, and a good grade of kraft pulp, suitable for a high-test wrapping paper, was obtained from each.

INDUSTRIAL INVESTIGATIONS.

On the whole, the principal activity of the Office of Industrial Investigations for the year was in cooperation on war problems along lines already mentioned. To a smaller extent the efforts of the force followed the usual channels, including the collection of industrial statistics. Through cooperation with the National Lumber Manufacturers' Association it was possible to collect data and issue a report on the production of lumber in 1916. Production was estimated at approximately 40,000,000,000 board feet, from over 30,000 sawmills. Though hampered by lack of shipping facilities in many regions and by scarcity of labor at many small mills, the active mills increased in number, and the total lumber cut amounted to nearly 2,000,000,000 feet more than in 1915.

For the first time since 1911 statistics were compiled and reports issued showing the number of crossties and poles purchased in the United States. Approximately 121,400,000 crossties were purchased in the calendar year 1915—112,800,000 by steam railroads and 8,600,000 by electric railways and light, heat, and power companies. The total number of poles purchased was 4,078,000.

In cooperation with the American Wood Preservers' Association, statistics were collected showing that in 1915 a total of 150,500,000

cubic feet of wood was treated and that 90,400,000 gallons of creosote and refined water gas tar, 26,750,000 pounds of zinc chloride, 5,675,000 gallons of paving oil, and 583,000 gallons of miscellaneous preservatives were used.

Between 400 and 500 wood-using establishments cooperated continuously, through the medium of the Wood Waste Exchange, for the closer utilization of wood waste. Much material previously used chiefly for fuel was more advantageously employed. The distribution of lists showing opportunities to buy or sell waste led to individual sales of from a few hundred feet to 30 carloads.

Data regarding current stumpage values were collected through correspondence with buyers and sellers of stumpage in every important timber region.

Quarterly lumber prices f. o. b. mill for both statistical and National Forest needs were compiled for important commercial species.

In cooperation with the Newsprint Manufacturers' Association, statistics were gathered on pulpwood consumption and pulp production in 1916. The 230 establishments reporting used 5,228,558 cords of pulpwood, 17 per cent more than in 1914, the last year for which similar statistics were compiled. A total of 3,271,310 tons of wood pulp was manufactured, an increase over 1914 of 378,160 tons.

Sets of commercial woods were prepared for free distribution to educational institutions and for exhibits from raw material contributed by lumbermen's associations.

The increased activities of woodlot owners, lumbermen, and wood-using establishments, their interest in markets and the care and preparation of material, and efforts at closer utilization were reflected in the increased number of requests for information from all parts of the United States.

MISCELLANEOUS.

There were added to the Service Library 913 books and pamphlets, making a total of 19,345. The list of bibliographies on special subjects was increased and the older ones revised. The index to articles on forestry keeps pace with the growth of the library, a total of 3,110 books and articles being indexed during the year.

Twenty-three new publications were issued. The distribution of Forest Service publications totaled 392,000 copies. About 240 public addresses were made, mainly at expositions and upon request from National Forest users, lumbermen's associations, and similar trade bodies, technical societies, and educational institutions. Exhibits were made at 39 fairs and expositions, and an exhibit at the California International Exposition, San Diego, Cal., was continued over from the preceding year. Twenty-three of these exhibits were demonstrated by members of the Forest Service. Lantern slides were loaned to more than 500 persons engaged in educational work. Additions to the lantern slide collection totaled 2,300, and 23 transparencies, 54 bromide enlargements, and 1,747 lantern slides were colored. Eight motion picture subjects were shown 280 times to more than 100,000 people. Traveling exhibits of photographs, maps, drawings, and wood samples were loaned to 215 schools and libraries.

REPORT OF THE CHEMIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CHEMISTRY,
Washington, D. C., October 13, 1917.

SIR: I submit herewith the report of the work of the Bureau of Chemistry for the fiscal year ended June 30, 1917.

Respectfully,

C. L. ALSBERG, *Chief.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The research of the year has yielded some interesting results, such as the discovery of a new sugar, sedoheptose, from *Sedum spectabile*, of a new method for the preparation of phthalic anhydride, of new sugar derivatives, of new facts concerning the proteins of agriculturally important seeds, concerning the arsenates and chlorarsenates of lead, and concerning the explosibility of carbonaceous dusts. Other important results deal with the identification of the volatile reducing substances of vinegar as acetylmethylcarbinol; the improvement of the methods for the separation of lithium from the other alkali metals, and for the identification of lactic and butyric acids in biological products. The results of about 60 investigations have been reported and some 50 others completed. Nine bulletins and two Farmers' Bulletins were published.

More attention has been paid than ever before to the study and demonstration of methods of conserving and preparing foodstuffs by drying, canning, pickling, preserving, and by the use of meritorious substitutes. In consequence, educational and demonstration work has grown very much during the year.

The enforcement of the Food and Drugs Act has undergone no radical changes. The disposition of the foodstuff and drug industries to cooperate with the Bureau of Chemistry continues to grow with a resulting improvement of the quality of their products and the elimination of spoilage and wastes. While the number of cases sent to prosecution is about the same as in former years, the amount of work involved in perfecting a case is becoming steadily greater, a certain indication of a very general improvement in commercial practice. The progress of the past 10 years has been so great that an effort has been made at the end of this report to summarize the effects of the enforcement of the Food and Drugs Act during the first decade since its enactment.

RESEARCH.

Plant chemistry.—Studies upon the effect of fertilizing wheat with nitrates and potash at different states of growth have demonstrated that nitrates applied when the wheat is beginning to head affect the

composition of the wheat but not the yield, while application when the plant is 3 to 4 inches high affects the yield but not the composition of the wheat.

Investigation has shown that the proteins of buckwheat flour contain a high percentage of basic amino acids, an important fact in estimating the value of buckwheat as a substitute for wheat.

The results of the study of some of the proteins of the peanut have been published, and in cooperation with the Bureau of Animal Industry it has been shown that peanut meal is a valuable feed for dairy cows. Farmers' Bulletin 751 on Peanut Oil has been issued jointly with the Bureau of Plant Industry.

The study of kafirin, an alcohol-soluble protein of kafir, has been published. The chemical and physical properties of the different parts of the kafir kernel have been studied. The germ and endosperm closely resemble those of corn. The germ contains oil. The bran, however, differs from that of corn in having a very high ether extract due to the presence of waxy material. These results indicate that it might be possible to obtain by milling kafir, products analogous to the commercial corn products.

Studies upon the occurrence of manganese in *Chrysanthemum cinerariaefolium*, upon the effect of boron on plant growth, upon gingerol, the pungent principle of ginger, and paradol, the pungent principle of grains of paradise, have been completed, and others on the composition of the bark of the *Viburnums*, of coca leaves, of *Pterocarpus* wood and of *Chaulmoogra* seeds are in progress.

A preliminary study of the volatile oil of Chinese mustard, *Brassica juncea*, and Japanese mustard, *Brassica cernua*, indicates that the oils are mixtures containing only in part allylisothiocyanate. The oil of *Brassica campestris annua sativa chinensis*, an adulterant of mustard, proved to be crotonylisothiocyanate, an oil without mustard qualities. Since the plant grows very vigorously, it is planned, in cooperation with the Bureau of Plant Industry, to utilize it either for greens and salads or for stock feed. The seeds yield over 40 per cent of fatty oil with the general characteristics of rape oil.

A study of *Piper bredemeyeri*, an adulterant of matico, *Piper angustifolium*, showed that the volatile oil like that of *Piper mandoni* contains dillapiol and is free from asaron obtained from genuine matico and from the camphor obtained from *Piper angustifolium* var. *Ossanum* and *Piper camphoriferum*.

Of the saponins of the yucca and agave species studied, all have been found to yield the same sapogenin when hydrolyzed. Upon hydrolysis the saponins of *Yucca filamentosa*, *Y. glauca* (*Y. angustifolia*), *Agave lecheguilla* and probably *radiosa* yield glucose, while that from *A. lecheguilla* also yields galactose and that from *Y. filamentosa* apparently glucuronic acid. Some of the results have been published.

The studies upon cotton reported last year have been continued and extended to other genera of *Hibisceae*, especially to wild cotton, *Thurberia*.

Many common foods of vegetable origin have been examined for oxalic acid.

Cereals—flour.—A bulletin upon the by-products of rice mills is in press. It gives data which should enable chemists to determine

whether rice brans, rice polishes, and similar by-products have been adulterated with hulls. Studies have also been made upon the difference in composition of natural brown and of polished rice. The pearling of barley and the use of barley as food have been investigated. The studies upon the determination of grades of flour, upon the effect of granulation upon the baking quality of flour and upon wheat substitutes in the baking of bread have been continued. It has been found possible to make good flour and bread from einkorn, emmer, spelt, and Polish wheat.

Fruits and vegetables.—The changes in chemical composition that take place in the ripening of California olives, oranges, grapefruit, and cantaloupes, and of Florida oranges and grapefruit have been investigated. Data upon the composition of sound and frozen lemons have been published. Several varieties of California avocados have been examined to assist growers in choosing the best varieties. Bulletin 452, "The Composition of American Grapes Grown in the Central and Eastern States," has been issued. Studies have been made to correlate the properties of tomato products with the quality of the raw material from which they are made with special reference to the amount of decayed material used in the preparation of such products.

Sirup, sugars.—Revisions of Farmers' Bulletins 477, "Sorghum Sirup Manufacture," and 516, "The Production of Maple Sirup and Sugar," are about to be issued. A chapter on "Jelly and Jelly Making" has been contributed to Farmers' Bulletin 853.

The investigations upon the two new heptose sugars, d-manno-ketoheptose from the avocado, and sedoheptose from *Sedum spectabile* have been printed. A number of papers have been published upon the relation between the rotatory power of sugars and sugar derivatives and their chemical constitution. A number of new sugar derivatives have been prepared and made the subject of publications.

Flora of foodstuffs.—The necessity of carefully examining floating grounds for the self purification of polluted oysters during a considerable period of time to guarantee against the existence of occasional sources of serious pollution before the commercial utilization of such grounds should be approved, has been demonstrated. Such grounds are available for each of the oyster-producing areas of the Atlantic seaboard and upon them oysters cleanse themselves more rapidly than has been supposed. Unpolluted shucked oysters, taken from muddy or dirty bottoms, may become polluted in the process of washing unless certain precautions be taken. Satisfactory methods for washing have been determined and the washing apparatus has been improved. Experiments upon the hibernation of oysters indicate that the oysters pass into this condition at a temperature of the water of somewhat above 45° F. Data on the bacteriology of the shell liquor and meats of oysters have been published.

In order to determine whether or not an injustice might be done to a bottler of drinking water through the examination of his product a long time after bottling, the changes that the flora undergoes on storage of the water were investigated. No such injustice can be done since most organisms, including *B. coli*, fall off in number during storage. A few species not regarded as associated with pollution may multiply, especially in waters with a certain mineral content. The presence of a considerable number of molds in bottled waters is clearly indicative of storage.

A paper upon "*Aspergillus fumigatus*, *A. nidulans*, *A. terreus*, n. sp. and their Allies," has been completed and papers upon the "Bacteriological Study of Hamburger Steak" and upon the *Aspergillus niger* group have been reported. A large collection of saprophytic organisms is maintained in growing condition and cultures from this collection are supplied to laboratories and collaborators seeking such assistance.

Beverages.—Bulletin 493, "Study of American Beers and Ales," has been issued. A study of the presence of arsenic in hops, undertaken in cooperation with the Bureau of Plant Industry, showed that this contamination is due to the presence of arsenic in the sulphur used in curing the hops. United States Patent No. 1216722 has been granted for a carbonating machine and some of the results of the experiments on methods of carbonation of beverages have been published.

Drugs and pharmacology.—Researches on organic periodides of antipyrin, iodantipyrin, and pyramidon have been printed. Investigations upon the pharmacological action of the fat-soluble dyes, of oil of chenopodium, of the iodides, of citrates, and of malates were published. Further work upon the action of dyestuffs, of heavy metals, and of organic acids is in progress.

Insecticides and fungicides.—In cooperation with the Federal Horticultural Board experiments were undertaken to discover methods of fumigating foodstuffs, such as seeds, without rendering them unfit for human consumption. The results of the investigation of the poisoning of bees by sprays will be published by the Bureau of Entomology. A paper has been issued on a new tree-banding material. The work on copper and sulphur fungicides has been continued with special reference to increasing their sticking qualities and reducing the amount of copper necessary. One paper has been published upon lead chlor arsenate and three upon the arsenates of lead. Bulletin 408, "Experiments During 1915 in the Destruction of Fly Larvæ in Horse Manure," was published jointly with the Bureau of Entomology.

Analytical methods.—There have been published methods for the estimation of lactic and butyric acids in biological products, of moisture in bread, of hydrocyanic acid in beans, of total solids in milk, of the folding endurance of paper and of the strength of paper when wet; also methods for the separation of lithium from the other alkali metals; for the separation and identification of food coloring substances and of fat-soluble dyes; for the detection of lime used as a neutralizer in dairy products, and of molds in drugs, foods, and spices; for the identification of emodin-bearing drugs; for the examination of methyl salicylate, and for the analysis of proprietary medicines. The description of an apparatus for the purification of mercury has been printed.

Studies were also made upon the estimation of citral, of monobromated camphor in migrain tablets, of fat in condensed milk and milk powders, of the acidity of cereal products, of added water in milk, of arsenic in sulphur and hops, upon the determination of fluorine in baking powders; also upon the electrolytic determination of lead, upon the identification of volatile oils, upon the separation

of aluminum from iron, upon the Kjeldahl method for determining nitrogen, and upon the analysis of brines.

It has long been the practice of the Bureau of Chemistry to systematically test the purity of all chemical reagents furnished to the Bureau's analysts. During the past two years much difficulty has been experienced in securing chemical reagents of satisfactory purity. This applies not merely to so-called chemically pure reagents but also to those reagents supposedly of high quality, which bear upon the label an analysis purporting to represent the amounts of impurities found in the reagent. In many cases these labels have been found to be directly misleading. For example, peroxide of lead which, according to the label, was supposed to contain only a trace of nitrates, actually contained from 20 to 30 per cent of lead nitrate. Particular difficulty has been encountered in the case of those reagents which are not very soluble, such as barium carbonate. However, during the last few months of the year there was some improvement in the quality of the reagents furnished. Such heavy chemicals as the mineral acids, ammonium hydroxide and similar products have usually been found to be of good quality and complying with the specifications under which they are sold.

CONSERVATION OF FOODSTUFFS.

The fleshing of poultry.—Experiments were conducted to demonstrate that wheat is not necessary or even desirable as a feed to fatten poultry. An economical ration has been found that will cause young chickens to gain over 35 per cent of their initial weight in 14 days.

Fish.—Bulletin 378, "Fish Meal: Its Use as a Stock and Poultry Food," and Bulletin 538, "Shrimp: Handling, Transportation, and Uses," have been published. A paper embodying analytical data on the food value of 20 common food fishes, with special reference to seasonal variation, has been completed. A bulletin on the methods of preserving fish by freezing, from the season when the supply is abundant to the time when it is scanty, has been finished. Work on the wet as compared with the dry chilling and packing of fish has been begun. Preliminary observations indicate that contact with water or melting ice causes the fish to absorb water, to lose soluble protein and to deteriorate in flavor.

Fermentation and pickling.—Work on potato silage for cattle food has been continued in cooperation with the Bureau of Animal Industry. The work on the fermentation of sauerkraut has been continued and extended to the household preservation of corn, beets, and string beans, using vinegar, or soured corn-meal extract as a starter, to prevent initial deleterious fermentation. The substitution of brining for pickling in the preservation of certain vegetables has also been examined.

Drying, starch production.—Progress has been made in the improvement of the methods of drying apricots and peaches. The work on the utilization of potatoes by drying and by the manufacture of starch has advanced to such a stage that these processes will soon be conducted on a commercial scale large enough to determine the question of costs. The preparation of sweet-potato flour and the

drying of a considerable number of vegetables has also been investigated.

Citrus fruits.—The production of citric acid on a commercial scale from cull lemons has been solved and citric acid has been sold at a price several cents above the market. The preparation of lemon oil has not yet been perfected. Orange pulp for the manufacture of marmalade has been prepared and distributed to the trade. Arrangements have been completed for the shipment of frozen orange pulp. Methods for preparing citrus peel for the market have been developed. An exchange service has been inaugurated by which producers and purchasers of citrus by-products have been brought together.

DEMONSTRATION.

Poultry and eggs.—The railroads are rapidly accepting and incorporating in their refrigerator-car specifications the modifications indicated by the experiments in the transportation of poultry and eggs. About 3,500 cars with heavier insulation, basket bunkers, and floor racks are now out of the shops or nearing completion. Several big systems have decided to modify all their refrigerator equipment as fast as it can be put through the shops.

Over 20 poultry and egg packing houses have been built during the past year on the basis of plans and information furnished by the Bureau of Chemistry. More than 10 egg-breaking rooms have been constructed and equipped according to the Bureau's plans and specifications. There are now hundreds of small, clean poultry packing houses, where, 10 years ago, were sheds, insanitary and filthy. The prime factor in this transformation has been the department's work to improve the handling of perishables. The egg-breaking business of the country has been revolutionized during the past 10 years—a result due to a combination of educational and regulatory work.

The Poultry and Egg Demonstration Car was sent through Tennessee, northern Mississippi, and Alabama and Kentucky. Forty towns were visited. More than 3,000 people came to the car.

Tomato products.—Bulletin 569, "The Sanitary Control of Tomato-Canning Factories," was issued, and an extensive educational campaign conducted to improve the production of tomato products, with special reference to increasing the manufacture of the more concentrated products, such as pulp and paste, for the purpose of conserving tin plate.

Sirup.—Improved methods of preparing cane sirup that will neither crystallize nor ferment have been demonstrated and are beginning to be adopted. Progress has been made in improving methods of clarifying this sirup.

Oysters.—Many of the oyster packing houses were visited and improved methods of sanitation, washing, and handling oysters were demonstrated.

Naval stores.—Additional sets of permanent rosin types have been prepared and deposited, one with the Chamber of Commerce at Mobile, Ala., one at the Food and Drug Inspection Laboratory, at Chicago, Ill., one at the Food and Drug Inspection Laboratory at San Francisco, Cal., and two sets have been retained at the Leather and Paper Laboratory in Washington as loan sets. All of these sets are

available for the use of interested parties in their respective territories. Two parties are engaged in demonstration work on improved methods of producing naval stores in the turpentine-producing States. The present methods of production are so crude and wasteful that there is much need for this type of work.

ENFORCEMENT OF THE FOOD AND DRUGS ACT.

Domestic foods and drugs.—The enforcement of the Federal Food and Drugs Act constitutes by far the largest part of the work of the Bureau of Chemistry. While the extent of the Bureau's activities in this direction can only be partially indicated in a statistical way, a few statistics may be of value. The records show that 371 recommendations for seizure and 719 recommendations for criminal prosecution were made through the offices of the Solicitor and of the Secretary to the Department of Justice. There were collected 5,649 official and 2,171 informal samples. The number of official samples analyzed by the field force in the laboratories is given in Table I, but this table does not include thousands of examinations made in the field, such as the candling of suspected shipments of eggs or the critical inspection of consignments of wormy or decomposed nuts.

TABLE I.—*Report of branch laboratories for year ended June 30, 1917.*

Laboratory.	Legal.	Import samples.		Floor inspection samples.	Interstate samples.			Miscellaneous samples.	Total samples analyzed.	Hearings.	
		Il-legal.	Re-leased with-out prejudice.		Legal.	Il-legal.	Check analysis.			Per-sonal.	By cor-respondence.
Central district:											
Chicago.....	142	237	12	1,903	541	440	186	371	1,929	151	150
Cincinnati.....	110	28	60	187	88	193	36	1,408	1,863	134	440
Minneapolis.....	15	67	10	226	200	109	5	146	552	74	147
New Orleans.....	49	77	4	1,016	53	116	26	152	477	59	147
St. Louis.....	6	2	.....	270	1,171	725	92	435	2,431	155	310
Total.....	322	411	26	3,602	2,053	1,583	345	2,512	7,252	573	1,194
Eastern district:											
Boston.....	234	360	63	9,381	161	167	113	212	1,310	342	237
Buffalo.....	13	21	9	32	121	109	2	252	527	82	80
New York.....	4,574	3,736	497	22,511	192	313	14	160	9,486	901	2,963
Philadelphia.....	196	155	50	1,964	49	112	.....	87	649	254	26
Porto Rico.....	306	350	173	3,107	10	331	.....	102	1,322	491	118
Savannah.....	62	17	3	.....	60	201	1	162	506	47	109
Washington.....	106	88	1	16	447	579	39	541	1,901	139	48
Total.....	5,491	4,727	796	37,011	1,040	1,862	169	1,516	15,601	2,256	3,601
Western district:											
Denver.....	29	3	6	58	96	101	.....	144	379	8	17
Honolulu.....	48	123	10	4,035	20	15	.....	34	255	138	.....
San Francisco.....	462	677	76	18,693	169	165	13	1,054	2,616	730	169
Seattle.....	310	321	47	7,340	92	82	.....	346	1,198	275	57
Total.....	849	1,129	139	30,126	377	363	13	1,578	4,448	1,151	243
Grand total.....	6,682	6,267	961	70,739	3,470	3,806	527	5,606	27,301	3,980	5,038

The Service and Regulatory Announcements published during the year contained 30 opinions and 500 notices of judgment. There were also issued Food Inspection Decision 168, amending paragraph

(e) of Regulation 29, which relates to marking the quantity of the contents of food in package form; and, upon the recommendation of the Joint Committee on Definitions and Standards, Food Inspection Decision 169, "Edible Vegetable Fats and Oils," and Food Inspection Decision 170, "Sweetened Condensed Milk, Condensed Skimmed Milk, Sweetened Condensed Skimmed Milk, Dried Milk, Dried Skimmed Milk, and Malted Milk."

In the interest of more efficient administration of regulatory matters the headquarters of the Eastern Food and Drug Inspection District were transferred from Washington to the United States Appraiser's Stores in New York City.

One peddler of spurious acetyl salicylic acid was convicted under the Food and Drugs Act. Certain other distributors of spurious neosalvarsan and acetyl salicylic acid were sentenced to prison through joint action of State and municipal officials, the Post Office, and the United States Departments of Justice and Agriculture. In one case a prison sentence was imposed after conviction for conspiracy in connection with adulteration of olive oil.

Special attention was given to shipments of polluted or spoiled food. A number of shipments of decomposed canned goods returned to packers or jobbers for the adjustment of claims were seized, evidence having been secured that the consignees had taken steps to dispose of the seized goods or previous similar consignments for food purposes. This practice of returning goods for the adjustment of claims for spoilage has led to certain abuses, which have been taken up with the industry in the hope that through cooperative action conditions may be controlled more effectively than in the past. Steps were taken to prevent the shipment of decomposed sardines, commonly described as "belly-blown." Inspection was made of the canning of California sardines, of tuna, and of abalone. Of the California fava-bean crop it was necessary this year to seize only a few cars of excessively wormy beans. The canning of decomposed navy beans has been suppressed very largely. The interstate shipment of oysters from polluted waters has practically ceased, and the practice of adulterating oysters and scallops with water has been checked in the main. Cooperation with State and municipal officials to control the shipment of bad eggs has been continued, and it is reported that the quality of the eggs reaching the large cities is much improved.

Cooperation to improve the milk supply has also continued, especially at St. Louis and in New England. The cooperation with local authorities begun last year in Texas to prevent the contamination of springs from which water is shipped in interstate commerce was this year extended to Arkansas, Wisconsin, and Missouri, with satisfactory results. A case in which the fairness of the standard of purity for mineral water proposed by the Bureau was attacked was decided favorably to the Government. Important issues of fact involving the methods of estimating decomposition of tomato products were determined in court.

Action was taken against shipments of worthless frozen oranges and of colored immature oranges and grapefruit, of evaporated apples and canned tomatoes adulterated with water, of mixtures of

cider vinegar with distilled vinegar or dilute acetic acid so manipulated as to simulate genuine cider vinegar, and of glue containing excessive zinc and other metallic impurities sold as edible gelatin.

Much work of an educational nature has been carried on, designed to secure a strict compliance with the requirements of the "net weight" amendment, and a number of prosecutions for violation of the amendment have been brought with success. Work has been in progress on tea, coffee, cocoa, spices, and similar free-flowing materials to establish suitable tolerances in filling packages of this class of products. In this connection a careful study was made of automatic weighing machinery.

With the aid of State feed officials, the inspection of low-protein meal and cake made from delinted cottonseed, reported last year, was repeated and extended to the Pacific coast. This year some of the mills placed fans above the separating screens, thus removing a considerable amount of hulls and linty matter. In many cases the labeling of the meal was changed to correspond with its true composition. Action was also taken against linseed meal adulterated with screenings and oats with weed seeds added to increase the weight per bushel.

Carelessness on the part of druggists of the District of Columbia in compounding even the simpler preparations resulted in prosecutions involving magnesium citrate solution, chloroform liniment, spirits of camphor, and the like. Similar conditions were found to prevail in Porto Rico.

Greater care than is now exercised is needed in the collection and preparation of native crude drugs to exclude earth, trash, and foreign plant matter. Some instances of such bad practice noted were: Pennyroyal containing 20 per cent of sand, unicorn root containing 15 per cent of earth, pipsissiwa "leaves" consisting almost entirely of stems. Accordingly, cooperation with the trade has been established to consider practical working standards for crude drugs not recognized in the United States Pharmacopœia or the National Formulary. Among the substitutions observed may be mentioned the substitution of nonofficial aconites containing no aconitine for aconite; of *Chimaphila maculata* for pipsissiwa (*Chimaphila umbellata*); of false unicorn root (*Chamaelirium luteum*) for true unicorn (*Aletris farinosa*); of *Aspidium aculeatum*, or an *Osmunda* species, probably *Osmunda cinnamomea*, for male fern (*Dryopteris filix-mas* or *Dryopteris marginalis*). The samples of true *Aspidium* collected were old and not up to the requirements of the Pharmacopœia.

Cooperation with State and Municipal Officials.—On August 5, 1916, the Association of American Dairy, Food, and Drug Officials adopted the following resolution: "That both State and Federal food and drug officials of this Association unite in the formation of smaller associations on a basis of community interests to study ways and means of handling local problems, and that their conferences be entirely of an executive nature." In consequence, associations have been formed by the officials of New England, of the Central Atlantic States, and of the South Central States. Members of the Bureau of Chemistry have taken an active part in the meetings of these associations. Perhaps the most significant development in cooperation of

the year is that active cooperation has been established with city officials. Many specific instances of cooperation are noted elsewhere in this report. A "Clearing House Letter" has been issued frequently to food and drug officials. Its purpose is to furnish officials all available current material bearing upon the enforcement of food and drug laws. A revision of the Manual of Procedure for the Guidance of State Health, Food, and Drug Officials was published in October, 1916. A compilation of the definitions and standards for foods and drugs that have been enacted into law by the several States was prepared and distributed to many officials. Concrete evidence of the spirit of cooperation now prevailing is found in the greater use by State officials of the Food and Drugs Act as an additional protection to their people. During the year there were instituted by 14 States, 117 such cases—25 seizures and 92 criminal prosecutions. These do not include cases instituted by the District of Columbia. Nearly all of these cases involved feeds. Only nine involved foods. There were no drug cases. The preponderance of feed cases will not be so great next year since during the present year there were collected by 24 States 330 official samples—232 feeding stuffs, 91 foods, and 7 drugs.

Imported foods and drugs.—Statistics concerning the import work are given in Table I. The quantity of imports has been greatly reduced. Regular brands and lines of products no longer form the bulk of the importations, and even standard articles, such as belladonna, have almost entirely disappeared. On the other hand, new products obtained from countries that have not heretofore shipped to the United States and new varieties of the old from new sources have been offered. Thus imitations of such Italian cheeses as Romano, Reggiano, and Parmesan have been imported from South America. The long trip through the tropics in ships not equipped with refrigeration not infrequently spoils them. The high price of beans has caused the extensive importation of many varieties of beans from many countries. Among them were so-called Burma or Rangoon beans from Asia and tapiramos beans from South America, which are known to yield hydrocyanic acid under some conditions. Shipments yielding appreciable amounts of hydrocyanic acid were therefore excluded as being dangerous to health. These poisonous beans are varieties of lima beans (*Phaseolus lunatus*) of various colors and in shape may not be unlike the common navy bean. On careful inspection they may be distinguished from the common bean by the fact that, unlike the common bean, they show distinct striations radiating from the eye to the periphery. There are also other less easily noticeable differences. The quality of the tomato paste imported has improved. Except for a few shipments of English mustard, European, including Russian, mustard seeds have entirely disappeared from the importations, and have been replaced by Chinese, Japanese, and Indian seeds. Indian rape or Tori (*Brassica napus* Var. *dichotoma*) was substituted for Indian brown mustard. Chinese mustard (*Brassica juncea*) seems often to be improperly collected, since it frequently contains much immature seed and weed seeds with *Eruca*. The use of genuine material from new botanical sources has been encouraged when properly collected and imported

under appropriate designations. Among the importations of this type which have been noted are chamomile flowers and valerian root from Japan, as well as of *Hyoascyamus muticus* for the manufacture of the alkaloid hyoscyamine. So-called Bombay or Indian coriander has almost entirely replaced the ordinary article. This coriander appears to be of the official species, but contains somewhat less volatile oil than the European variety, and several shipments have been detained for this reason. Among the drug adulterations that have been noted may be mentioned the substitution of *Inula britannica* for arnica flowers (*Arnica montana*); *Solanum nigrum* for belladonna (*Atropa belladonna*); *Xanthium strumarium* for stramonium (*Datura stramonium*); *Lippia berlanderi* and *Origanum vulgare* for marjoram (*Majorana hortensis*); *Heteropteris pauciflora*, *Ipecacuanha fibrosa*, and *Ionidium* species for ipecac (*Cephaelis ipecacuanha*); *Ballota hirsuta* for horehound (*Marrubium vulgare*); *Foeniculum piperitum* for fennel (*Foeniculum vulgare*); *Rheum rhaponticum* for rhubarb (*Rheum officinale*). As much as 20 per cent of the toxic plant *Tephrosia apollinea* was found in a shipment of Tinnevely senna (*Cassia angustifolia*). A fungus growth closely resembling the sclerotium known as "ergot" was found in caraway (*Carum carvi*) and in cumin (*Cuminum cuminum*).

From time to time it has been suggested by importers that the Bureau issue announcements of the action taken on detained shipments of foods and drugs in a manner similar to those now required to be issued by law as notices of judgment concerning the outcome of prosecutions under the domestic sections of the law. This matter was discussed at a hearing. It became apparent in the course of the hearing that the information to be of value should be specific and descriptive and that the issuance of such information could not be effected without identifying either directly or by implication the importers concerned. For this reason and for the further reason that these detentions are not a matter of court record, it was decided that since the importers have no opportunity ordinarily for investigating the character of the goods before arrival, the reflection which such publications would make would not be warranted and the Bureau would not publish a list of special detentions.

COLLABORATION.

Collaboration with the Post Office Department led to some notable results during the year. Through the assistance given by the Drug Division a considerable number of fraud orders were issued. Members of the Drug Division also assisted the officials of the Post Office Department in the trial of a number of cases. In the case of a drug fraud a fine of \$30,000 was imposed. This case has paved the way for prosecuting this collaborative work more vigorously against products which are subject to the postal laws rather than to the Food and Drugs Act. All in all 81 samples of medicines and drugs sent through the mails have been analyzed for the Post Office Department.

The laboratories in Washington analyzed during the year 4,190 samples for other bureaus of the Department of Agriculture; for other executive departments and government establishments, 681 samples were analyzed, as shown in Table II. This total does not

include samples which were analyzed by the branch laboratories of this Bureau. These are included among the miscellaneous samples given in Table I.

TABLE II.—*Miscellaneous analyses for other branches of the Government.*

Department of State.....	2
Department of the Treasury.....	2
Department of War.....	32
Department of Justice.....	2
Post Office Department.....	2
Department of the Navy.....	83
Department of the Interior.....	3
Department of Commerce.....	9
Government Printing Office.....	3
The Panama Canal.....	23
District of Columbia.....	16
Federal Trade Commission.....	3
Miscellaneous.....	501
Total.....	681

TEN YEARS OF THE FOOD AND DRUGS ACT.

The Food and Drugs Act is a remedial statute with penal provisions, and its purpose is to correct the practice of adulterating and misbranding foods and drugs and thereby protect the health of the people.

The first 10 years of the enforcement of the Food and Drugs Act of June 30, 1906, ended January 1, 1917. It is therefore fitting at this time to present a brief history of the act, and the work accomplished under its authority during the decade.

It is perhaps impossible for any one correctly to estimate the general effect of the Food and Drugs Act. To state that more than six thousand cases have been terminated in the courts during the first decade since the enactment of the act, that manufacturers have been cited to hearing more than forty thousand times, that many thousands of factory inspections have been made, that more than seven hundred and fifty thousand shipments of food and drugs, both domestic and imported, have been examined, gives but an imperfect indication of results. The accomplishments under the Food and Drugs Act can be proven only in part by reference to the files of the Bureau. A measure of the corrective influence of the act is the true measure of accomplishment. Perhaps such an estimate can best be gained, though imperfectly, by considering the effect of the act upon food and drug control by the States, upon the development of the food and drug industries, and by the enumeration of some of the principal abuses that have been corrected.

One of the consequences of the enactment of the Food and Drugs Act was to stimulate the enactment of similar legislation in many of the States, in order to control the local traffic in foods and drugs which, since no interstate commerce is involved, is not subject to the Federal Act. For example, in 1906 a considerable number of States had feeding-stuffs laws, but many had none. A State could not prosecute a manufacturer unless he were a citizen of that State. The Federal law supplements the State law in this respect, and now most of the States have similar laws. Naturally, in the beginning much

confusion and apparent conflict between the local and Federal laws and the local and Federal administration of laws seemed to exist, so that it was difficult for the two sets of officials to supplement one another. In consequence it was often necessary for manufacturers to make very special preparation for shipment to certain States at extra cost, which naturally was passed on to the ultimate consumer. This lack of uniformity has been remedied to a considerable degree by two agencies: (1) The Joint Committee on Definitions and Standards, consisting of representatives of the Association of American Dairy, Food and Drug Officials, of the Association of Official Agricultural Chemists, and of the Department of Agriculture, and (2) by the Office of Cooperative State and Federal Food and Drug Control, established in the Bureau of Chemistry in 1914. The Joint Committee, which was established by the Secretary of Agriculture, proposes standards and definitions for the consideration of State officials which, after adoption by these officials, are adopted by the Department of Agriculture for the guidance of its officials. In this manner independent and conflicting action by independent groups of officials is, to a large extent, voluntarily obviated. The Bureau of Chemistry's Office of State and Federal Cooperative Food and Drug Control is essentially a State agency in a Federal bureau. It is a special agent for the State or municipal official. It acts as a clearing house for all matters dealing with food and drug control so that all the officials of the country may be kept informed upon all that is in progress throughout the country. It furnishes regularly information and assistance to State and municipal officials. The result is that Federal, State and municipal officials are able to supplement each other more effectively than was possible early in the law's enforcement. This is well exemplified by the fact that during the fiscal year ending June 30, 1917, one hundred and seventeen cases were instituted under the Federal law by State officials, exclusive of the officials of the District of Columbia, and that these officials have collected more than three hundred official samples for consideration by the Bureau of Chemistry. Through these two agencies a way has been found, so far as the Food and Drugs Act is concerned, to overcome in a fairly satisfactory manner some of the difficulties that arise out of our form of Government with its conflict of Federal and State jurisdiction.

The Food and Drugs Act was among the first of that group of laws which today would be classed as laws for the prevention of unfair competition. The suppression of fraud upon the consumer and of unfair competition among business rivals are but the two faces of the same coin. In consequence the food industries are sincerely and effectively supporting and helping the Bureau of Chemistry to enforce the law. Indeed, the Bureau is not infrequently appealed to by the industries to compel the cessation of unfair practices and to encourage the standardization of products when the industry is incapable by itself of bringing about these results. Instances of this kind may be found in the citrus-fruit industry, the evaporated-milk industry, and the sardine industry. The act has been one of the influences which has helped to draw competitors together into associations like the guilds of the Middle Ages, associations shorn of the special privileges which the ancient guilds often enjoyed. These associations have come to understand the value of constructive work

and some of them devote considerable sums annually to experimental research designed to solve the technical problems with which the industry is confronted. Thus, there is made available to the small manufacturer scientific assistance which would ordinarily be obtainable only by large corporations maintaining their own staff of investigators. Since the Bureau of Chemistry has always regarded it as its duty not merely to report violations of the law but also to prevent violations by constructive work intended to improve methods of manufacture, it cooperates actively with such associations of manufacturers. Such cooperation by the various Government agencies is bound to exert the profoundest influence on the country's industrial and social development.

The best evidence that many of the abuses formerly occurring in the food industry have ceased, is to be found in the fact that the violations of the Food and Drugs Act observed today are hardly comparable with those which obtained during the first few years of the past decade. Most of the staple food products now found in violation are either of a higher grade than formerly, or are products of the clever adulterator, that is of those who have more or less anticipated the ordinary means of detection by so manipulating their products that not infrequently the adulteration can be detected only by the most detailed and painstaking chemical analysis coupled with factory inspection. In consequence there has been a decided change in the direction of the work. It has of recent years developed quite noticeably in the direction of factory sanitation, of the study of spoilage and decomposition of foodstuffs, and of the improvement through laboratory research of the methods of detecting the more refined new types of adulterations.

The Food and Drugs Act's chief contributions to the safeguarding of the peoples' health have been its effect upon the drug and patent medicine industry, upon the control of the traffic in polluted, decomposed or filthy foods and upon the elimination from foodstuffs of contamination with poisons such as lead and arsenic which entered the product because of the use of impure reagents in the process of manufacture, or of utensils constructed of improper materials.

The misbranding in regard to therapeutic value of hundreds of alleged cancer cures, of alleged cures for coughs, colds, consumption, etc., of alleged cures for diseases of the kidney, epilepsy, St. Vitus Dance, and the like, has been corrected. Unfortunately in many instances the result has been merely to transfer the false and fraudulent claims from the package to newspapers and other publicity media over which the act exercises no jurisdiction. The law requires the labels of patent medicines to declare the presence of any habit-forming drugs such as opium or cocaine or alcohol contained in them, thus preventing the innocent development of the drug habit which undoubtedly was common. This provision of the law is particularly valuable in warning mothers against the use of so-called infants' soothing sirups containing opium. It has without question done much to limit the use of medicines as tipples. In consequence of the requirement that habit-forming drugs be declared upon the label the formulæ of some nostrums was changed by the reduction or even the elimination of the habit-forming agent. Drug addiction, in fact, was so prevalent that frauds in the treatment of these unfortunates

became frequent. In most instances the treatment contained the very drug to which the person was addicted. Many of the purveyors of these treatments were successfully prosecuted. Similar action was taken in regard to catarrh and asthma remedies containing cocaine. When the act went into effect there were 30 soft drinks containing small amounts of cocaine, practically all of which were suppressed. There can be no doubt that the act was an important factor in aiding the passage of the Harrison Anti-narcotic Law, which more effectively controls habit-forming narcotics than is possible under the Food and Drugs Act. Much has also been done to control the indiscriminate use of so-called headache mixtures containing dangerous depressing drugs and of dangerous cosmetics making therapeutic claims. The act has vastly improved the manufacture of pharmaceuticals such as extracts and tablets, and raised the quality of the supply of crude drugs since the importations of crude drugs are examined at the ports of entry. Finally, it may be stated that much evidence obtained in connection with the enforcement of the Food and Drugs Act was submitted to the Post Office Department and resulted in the issuance of fraud orders, a more effective way of dealing with many products than prosecution under the Food and Drugs Act. Among these may be mentioned lost manhood restorers, consumption cures, cancer cures, mechanical devices referred to in medical literature as "gas-pipe therapy," weight producers and general medicine schemes by which diagnoses are made and treatment administered by mail.

The methods of handling and labeling soft drinks and mineral waters have been revolutionized. One sure index of this improvement is the fact that the cleaning and bottling machinery of five years ago is today out of date. The collection of a sample of mineral water which is contaminated is now unusual, while 10 years ago most of the samples collected were in an unsatisfactory condition. Regarding false labeling, it may be pointed out specifically that misrepresentations regarding so-called lithia waters and radioactive waters, as well as the great majority of exaggerated therapeutic claims, have been practically eliminated from the labels of these products. Today the so-called lithia waters and radioactive waters are not to be found on the market.

Much has also been done to safeguard the milk supply imported from Canada or shipped in interstate commerce. In the same manner, with the cooperation of the United States Public Health Service, the traffic in oysters polluted with sewage has been controlled. The traffic in decomposed canned fish, so-called "do-overs," has practically ceased. The shipment of decomposed canned beans and of decomposed shell eggs has been lessened. The manufacture of foods from refuse, especially tomato products, has been decreased and the sanitary conditions in food factories have correspondingly improved.

Ten years ago much of the baking powder, of the gelatin, and some of the confectionery was contaminated with small quantities of lead or arsenic. This is not the case to-day. The coloring of canned peas with copper has been suppressed, as has the use of a number of dangerous preservatives.

Among the practices not dangerous to health that have been controlled may be mentioned the addition of water to grain, to dried fruit, to sirups, to fruit juices, to oysters, to canned tomatoes, and the

like; the substitution of glucose for cane or beet sugar, of synthetic for natural products in flavoring extracts, of sugar sirup for maple sirup, and of hulls for cottonseed meal. The list might be extended vastly.

The act exercises control not merely over interstate shipments but also over imports. Indeed, it is somewhat broader in scope in its application to importations than to domestic shipments. In the last 10 years over 100,000 import shipments have been sampled and many times that number inspected. Practically all the various violations of the act mentioned in the preceding paragraphs have also been dealt with in connection with importations.

While the accomplishments of the Food and Drugs Act have been considerable, it must be admitted that it has its serious limitations. Especially conspicuous ones are the lack of legal standards for foods, of authority to inspect warehouses, and of any restriction whatever upon the use of many of the most virulent poisons in drugs; the limitations placed upon the term "drug" by definition which render it difficult to control injurious cosmetics, fraudulent mechanical devices used for therapeutic purposes, as well as fraudulent remedies for obesity and leanness; the limitation of dangerous adulterants to those that are added so that the interstate shipment of a food that naturally contains a virulent poison is unrestricted. Furthermore, the law fails to take cognizance of fraudulent statements covering foods or drugs which are not in or upon the food or drug package. Greater flexibility to prescribe the disposition of imports is also desirable. The Secretary of Agriculture has at one time or another recommended legislation to fill most of these gaps in the law. It should also be noted that at present there is no Federal law which prohibits unregistered or unlicensed persons from sending into interstate commerce medicinal agents, poisons, and the like, although they can not be sold locally by them nor indiscriminately even by registered or licensed pharmacists or physicians.

The constitutionality of the act has been questioned repeatedly without success. These cases and many others have clarified the significance of most of the provisions of the act, though certain other provisions, such as those dealing with "compounds," "blends," and "imitations," and the recent amendment requiring that foods in package form be labeled with the quantity of the contents of the food in the package still await complete interpretation by the courts.

Many matters of procedure have been fixed by the courts. Thus, in *United States v. J. Lindsay Wells Co.* (186 Fed. 248) and in *United States v. Baumert et al.* (179 Fed. 735), it was held that in cases under section 2 of the act the procedure may be by information, which is a more expeditious and economical procedure than by indictment. In *United States v. 443 Cans of Frozen Egg Products* the Supreme Court held that cases *in rem* arising under section 10 of the Food and Drugs Act are of the character of common-law actions, after the seizure of the goods, and subject to review only upon writ of error, in accordance with the rules of the common law. In *United States v. 5 Boxes of Asafetida* (181 Fed. 561) it was held that section 10 of the act defines fully when and under what circumstances foods and drugs shall be forfeited, and is independent of and distinct from section 2, and it is unimportant in forfeiture proceedings whether a

person on the same statement of facts could be convicted under section 2. Liability to seizure was held to depend upon whether the articles are adulterated or misbranded at the time of seizure, and not whether they were adulterated or misbranded at the time of interstate shipment. In *United States v. Morgan* (220 U. S. 274, Office of the Solicitor Circular 58, Notice of Judgment 1992), the Supreme Court held that the notice required to be given parties from whom samples of food and drugs are procured by the Department for purposes of investigation is not jurisdictional, and that the hearing given to the parties is not judicial. In *United States v. J. L. Hopkins Co.* (199 Fed. 649, Notice of Judgment 2436) it was held that jurisdiction exists in the Federal Court of the District from which the goods were shipped, even though the defendant did not reside in that District. The court also held that violations of the Food and Drugs Act are subject to the general statute of limitations, which is three years, and that immediate prosecution is not required by section 5 of the act.

With reference to what constitutes an interstate shipment, it was held in *Philadelphia Pickling Co. v. United States* (202 Fed. 150, Notice of Judgment 2456) that a shipment by the manufacturer from his place of business in one State to his place of business in another State for testing of an adulterated article constituted a violation of the Food and Drugs Act. In *United States v. Powers-Weightman-Rosengarten Company*, a case under the Insecticide and Fungicide Act, a law which in general is analogous to the Food and Drugs Act, it was held that it is not an interstate shipment if goods in passing from one point in a State to another point in the same State traverse another State. (Insecticide and Fungicide No. 75, Dom. No. 1055.) In *Hipolite Egg Co. v. United States* (220 U. S. 45, Notice of Judgment 1043) it was held that adulterated articles of food which have been transported in interstate commerce are subject to seizure and condemnation as long as they remain in the condition in which they were transported, that is, "in the original, unbroken packages."

The validity of the guarantee section, section 9 of the act, was upheld in *United States v. Charles L. Heinle Specialty Company* (Notice of Judgment 389, Circular 29, Office of the Solicitor). In *United States v. Mayfield, et al.* (177 Fed. 765, Notice of Judgment 326), the court instructed the jury that a guaranty is available to a dealer only when it relates to the identical article shipped by him and affords no defense to him when the guaranty relates only to a constituent used by him in manufacturing the article shipped; and further, that the officers of a corporation which manufactured an adulterated or misbranded food product shipped by its manager in interstate commerce are subject to prosecution therefor when they authorized the manager to operate the plant and sell the product without restriction, and the previous course had been to ship on orders to other States. In *Steinhardt Bros. Co. v. United States* (191 Fed. Rep. 798, Office of the Solicitor Circular 57) it was held that the guaranty contemplated under section 9 of the Food and Drugs Act to afford protection to the party making an interstate shipment of the adulterated or misbranded article must have been given prior to such shipment. In *Glaser, Kohn and Company v. United States* (Circular 84, Office of the Solicitor, 224 Fed. 84,

Notices of Judgment 3400 and 4036) it was held that a guaranty in the form of a letter, expressed to be good until revoked on all articles sold continued to be good until revoked.

In accordance with the regulation originally made for the administration of the act it became the custom for manufacturers to place upon their labels the legend "Guaranteed by ----- under the Food and Drugs Act, June 30, 1906." In 1913-14 the regulations were amended so as to require the cancellation of general guaranties filed with, and serial numbers assigned by, the Department and to prohibit the use upon labels of the above legend on the ground that the use of the legends and numbers upon packages of food and drugs conveys the false and misleading impression to the public that the articles have been examined and approved by the Government and that the Government guarantees that they comply with the law.

The word "package" as used in the act means the package which passes into the possession of the public, of the real consumer, and the words "original unbroken package" relate to the package in the form in which it is received by the vendee or consignee. (*Dr. J. L. Stephens Company v. United States*, Notices of Judgment 1891 and 2511, Circular 72, Office of the Solicitor). This decision is supported in effect by the decision of the Supreme Court in the State of Wisconsin *v. McDermott* (*McDermott v. State of Wisconsin*, 143 Wis., 18; 228 U. S., 115), a case not instituted by the Federal Government. In *United States v. 5 Boxes of Asafetida* (181 Fed., 561) it was decided that the taking of samples by claimant for the purpose of examination did not destroy the commercial form of the packages and did not incorporate the goods with the property of the State so as to remove them from the jurisdiction of the act over original packages.

With reference to the adulteration and misbranding of foods the following cases are of special interest. It was held in *United States v. Lexington Mill and Elevator Company* (232 U. S., 399, Circular 79, Office of the Solicitor) that an article of food is adulterated if, because of any added poisonous or other deleterious ingredient, it may by any possibility injure the health of the strong or the weak, the old or the young, the well or the sick, or any of these, or, conversely, that an article of food is not adulterated, within the meaning of the provision of the act by which an article is declared adulterated, "if it contain any added poisonous or other added deleterious ingredient which may render such article injurious to health," "if it can not by any possibility, when the facts are reasonably considered, injure the health of any consumer," even though it contain "a small addition of poisonous or deleterious ingredients." The same provision of the act was further construed by the Supreme Court in *United States v. 40 Barrels and 20 Kegs of Coca Cola* (241 U. S., 265; Circular 86, Office of the Solicitor, Notice of Judgment 4801) in holding that the caffeine in Coca Cola is an "added" ingredient within the meaning of the act contrary to the opinion of the circuit court of appeals, which had held in effect that a mixture or compound sold under its own distinctive name is not adulterated because it contains as one of its normal ingredients a poisonous or deleterious substance, since such poisonous or deleterious substance is not added to the article within the meaning of the provision, but is a part of it (215 Fed.

535, Circular 80, Office of the Solicitor, Notice of Judgment 4032). In *United States v. American Chicle Company* the court instructed the jury, in effect, that if they found that an article contained but a trace of a certain ingredient it was misbranded if named after that ingredient. In *United States v. 7 Cases of Buffalo Lithia Water* (Circular 78, Office of the Solicitor, Notices of Judgment 3869 and 4310) a similar principle is involved. An article labeled "Buffalo Lithia Water" was condemned as misbranded on the ground that the article did not contain sufficient lithium to entitle it to be labeled "lithia water." In *Hudson Manufacturing Company v. United States* (192 Fed. Rep., 90, Notice of Judgment 1451) it was held, in effect, that the use of a designation without well-known trade meaning for an imitation food product without giving any indication of what the article is composed, shows a clear case of misbranding. In *United States v. Charles G. Dade* (40 App. D. C. 94, Notice of Judgment 2516) it was held that the presence of *Bacterium coli* and *Streptococci* in milk in certain cases indicated decomposition or the presence of fecal matter which rendered the milk filthy. Analogous decisions have been rendered with reference to the pollution of oysters, the decomposition of tomato products, of beans, and of other foods, although the action of the courts has not always been uniform. In *William M. Galt and Company v. United States* (39 App. D. C. 470, Notice of Judgment 2396) it was held that the presence of worms in flour rendered it adulterated because it was "filthy" within the meaning of that word as used in the act, "even conceding that the worms, insects, and beetles could be separated therefrom, the flour would still be contaminated by reason of its contact with them and would still contain more or less husks and excreta from the worms; that is, it would still be filthy within the meaning of the act." In *United States v. 13 Crates of Frozen Eggs* (208 Fed., 950, Notice of Judgment No. 2859) it was held that the act prohibits the transportation in interstate commerce of filthy, decomposed, or putrid eggs, and that such eggs, which have not been denatured, may be seized and condemned, even if the shipper intended them to be used for tanning, not for food purposes.

With reference to the adulteration and misbranding of drugs, the following are some of the more important decisions: In *United States v. Sixty-five Casks of Liquid Extract* (170 Fed., 449, Notice of Judgment 284) the claimants contended that the quantity or proportion of the drugs specified in section 8 of the act need not be declared in case of drugs which are not labeled or branded. The court ruled adversely to this contention, deciding, in effect, that the act not only requires that drugs shipped in interstate commerce and labeled shall not be misbranded, but requires that they shall bear labels conforming with its provisions. In *United States v. Antikamnia Chemical Company* (231 U. S., 654; Circular 76, Office of the Solicitor) the effect of the decision of the Supreme Court was to sustain the validity of a regulation which requires that, in declaring the quantity or proportion of derivatives of any substance specified in section 8 of the Food and Drugs Act, the name of the specified substance, in addition to the trade name of the derivative, shall be stated. It was held, further, that the act itself requires that the name of the specified substance be stated if the article contain

a derivative of it. In *United States v. Lehn and Fink* (Circular 49, Office of the Solicitor) it was held that section 7 of the act which declares a drug to be adulterated if it "differs from the standard of strength, quality, or purity as determined by the test laid down in the United States Pharmacopœia * * * official at the time of investigation," is not *ex post facto* legislation and therefore not unconstitutional. It was further held that Congress in enacting this section did not delegate legislative power, but merely prescribed the method of ascertaining facts upon which the operation of the statute was to depend. In *Dr. L. J. Stephens Company v. United States* (Vid. Supr.) it was held that physicians' prescriptions are not exempt from the operations of the act.

United States v. Johnson (221 U. S., 488, Notice of Judgment 1058) was decided adversely to the Government. In this case misbranding was alleged of a so-called "mild combination treatment for cancer," consisting of several packages bearing statements that the treatment would effect the cure of cancer. It was held, in effect, that false and misleading statements as to the curative or therapeutic effects of medicines did not come within the prohibition of the law. The President thereupon addressed a message to Congress urging remedial legislation. On August 23, 1912, the act was amended (37 Stat., 416). The constitutionality of this amendment was sustained by the Supreme Court in *Seven Cases et al. v. United States* (239 U. S., 510, Circular 85, Office of the Solicitor).

On March 3, 1913, the act was further amended so as to require articles of food in package form to bear a statement showing the quantity of the contents in terms of weight, measure, or numerical count (37 Stat., 732).

On June 16, 1913, rule 39 of the rules and regulations made for the enforcement of the Food and Drugs Act was revoked. Under that rule domestic meat and meat-food products which were prepared under Federal inspection were exempted from the provisions of the Food and Drugs Act. As a result of the revocation, the power of seizure of unsound meat and meat-food products in the course of interstate commerce can be and has been exercised. Under the Meat Inspection Act spoiled meats could be condemned and destroyed only when they were found within establishments in which Federal inspection was maintained.

REPORT OF THE CHIEF OF THE BUREAU OF SOILS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., September 15, 1917.

SIR: I have the honor to transmit herewith a report covering the operations of the Bureau of Soils for the fiscal year ended June 30, 1917.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. D. F. HOUSTON,
Secretary of Agriculture.

SOIL SURVEY.

The work of constructing the soil map of the United States was carried on by the Soil Survey during the year and an area of 37,225 square miles of mapped country was added to that previously mapped in detail, bringing the total area covered to date up to 445,825 square miles. This is approximately a fourth of that part of the total area of the United States that will be covered by detailed surveys. The rest of the area consists of deserts and mountainous country that will be mapped by reconnaissance methods and at a rate much more rapid than that at which detailed work is done and at a much lower cost.

During the year 9,182 square miles were covered in reconnaissance work, bringing the whole area mapped in that way to date up to 493,494 square miles. With the exception of the reconnaissance work done in Ohio, all this work has been done either in regions of rough topography or in those where development had not gone very far at the time the work was done. More than half of it has been done in the Great Plains region east of the Rocky Mountains.

The best results in a work like that of the Soil Survey are obtained by a combination of detailed local knowledge with that of a comprehensive nature. The work can best be done by parties of men made up in part of those with broad knowledge of soil conditions over a wide area combined with sound training in the fundamental principles of soil development and in part by men who are thoroughly familiar with local conditions and needs. This is effected by the Soil Survey by intimate cooperation between the Bureau of Soils and some State institution charged with the investigation of soils or agriculture in the State concerned. This cooperation is in most cases an active one in which the State and the Government pay the cost of the work jointly. In other cases, those in which the State is unable to cooperate in an active way on account of lack of funds, a sympathetic cooperation generally is maintained, the Bureau of Soils consulting the State officials in the selection of areas to be mapped and in other details of the work.

At the close of the fiscal year 1917 the Bureau of Soils was co-operating actively in soil-survey work with 20 States and sympha-

thetically with 7 others, covering all the work done by the bureau except certain areas surveyed in cooperation with other bureaus and departments of the Government.

The statistical details of the work of the year are shown in the tables appended to this report. It will suffice to mention that of the total area of 37,225 square miles covered in detailed work during the year, 15,984 square miles were included in the cotton States and 2,230 square miles in the Pacific Coast States. The rest of the work was done in the States east of the Rocky Mountains and north of the cotton States.

The study of the relation of soils to truck crops was carried on during the year mainly in the Norfolk district and on the eastern shore of Maryland and Virginia. Field work was completed in the Norfolk district in the autumn of 1916 and the report on the area was prepared during the winter. Work on the eastern shore was begun early in the spring of 1917 and continued to the end of the fiscal year.

The land classification work in the National Forests covered about 35 projects, located in 10 States. The field work and reports were completed for all of them, and about half of them have been finally approved and passed on to the Forest Service.

Cooperation with the Office of Indian Affairs, the Reclamation Service, and with the Bureau of Plant Industry of this department was carried out in a number of projects in Arizona, Wyoming, Utah, and Maine during the year.

The Section of Soil Information and Advice has answered a great many inquiries and given much local advice in person during the year. The work of the section was greatly increased by the agitation for garden planting last spring.

On account of the necessity for increasing the production of food crops to meet the present situation an investigation of the records and results of the soil survey was begun during the year to determine the soils most productive of the staple crops. The investigation has covered up to the present time the soils used for the production of corn and wheat and their relative importance.

TABLE I.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1917.*

DETAILED.

State.	Area.	Area surveyed.	
		Square miles.	Acres.
Alabama.....	Fayette County.....	643	411, 520
	Lowndes County.....	138	88, 320
	Marion County.....	207	132, 480
	Monroe County.....	259	165, 760
	Morgan County.....	150	96, 000
	Shelby County.....	540	345, 600
	St. Clair County.....	645	412, 800
Arizona.....	Gila Valley area.....	295	188, 800
Arkansas.....	Drew County.....	847	542, 080
	Faulkner County.....	651	416, 640
California.....	Howard County.....	602	385, 280
	Santa Maria area.....	323	206, 720
	Ventura area.....	739	472, 960
Florida.....	St. Johns County.....	655	419, 200
Georgia.....	Burke County.....	956	611, 840
	Jasper County.....	379	242, 560
	Lowndes County.....	482	308, 480
	Mitchell County.....	250	160, 000

TABLE I.—*Individual areas surveyed and mapped during the fiscal year ended June 30, 1917—Continued.*

DETAILED—Continued.

State.	Area.	Area surveyed.	
		Square miles.	Acres.
Indiana.....	Benton County.....	408	261,120
	Lake County.....	106	67,840
	Porter County.....	415	265,600
Iowa.....	Blackhawk County.....	105	67,200
	Clay County.....	563	360,320
	Henry County.....	260	166,400
	Mitchell County.....	1,348	222,720
	Ringgold County.....	540	345,600
Kentucky.....	Shelby County.....	427	273,280
Louisiana.....	La Salle Parish.....	443	283,520
	St. Martin Parish.....	525	336,000
Maine.....	Aroostook County.....	225	144,000
Maryland.....	Howard County.....	253	161,920
Michigan.....	Calhoun County.....	1,249	159,360
Minnesota.....	Anoka County.....	459	293,760
Mississippi.....	Amite County.....	714	456,960
	Covington County.....	410	262,400
	Madison County.....	725	464,000
	Newton County.....	568	363,520
Missouri.....	Barry County.....	1,579	370,560
	Callaway County.....	808	517,120
	Knox County.....	123	78,720
	Texas County.....	1,402	257,280
Nebraska.....	Box Butte County.....	1,728	465,920
	Dodge County.....	1,344	229,160
	Fillmore County.....	576	368,640
	Hall County.....	528	337,920
	Kimball County.....	958	613,120
	Morrill County.....	322	206,080
	Wayne County.....	217	138,880
New Jersey.....	Belvidere area.....	470	300,800
	Millville area.....	731	467,840
New York.....	Cortland County.....	1,163	104,320
	Yates County.....	343	219,520
North Carolina.....	Beaufort County.....	840	537,600
	Bertie County.....	491	314,240
	Cleveland County.....	488	312,320
	Halifax County.....	1,208	133,120
	Stanly County.....	416	266,240
North Dakota.....	Sargent County.....	219	140,160
Ohio.....	Mahoning County.....	340	217,600
	Marion County.....	409	261,760
	Sandusky County.....	413	264,320
Oklahoma.....	Canadian County.....	170	108,800
	Payne County.....	678	433,920
Pennsylvania.....	Clearfield County.....	1,142	730,880
	Mercer County.....	141	90,240
South Carolina.....	Marlboro County.....	519	332,160
	Newberry County.....	142	90,880
Tennessee.....	Maury County.....	402	257,280
Texas.....	Bowie County.....	319	204,160
	Denton County.....	239	152,960
	Lubbock County.....	868	555,520
	Reeves County.....	665	425,600
Vermont.....	Windor County.....	1,203	129,920
Virginia.....	Accomac and Northampton Counties.....	525	336,000
	Pittsylvania County.....	359	229,760
Washington.....	Benton County.....	1,873	558,720
West Virginia.....	Jefferson, Berkeley, and Morgan Counties.....	769	492,160
Wisconsin.....	Door County.....	469	300,160
	Rock County.....	414	264,960
	Milwaukee County.....	235	150,400
	Waupaca County.....	473	302,720
Total.....		37,225	23,824,000

RECONNOISSANCE.

California.....	Middle San Joaquin area.....	4,264	2,728,960
	Central Southern area.....	4,918	3,147,520
Total.....		9,182	5,876,480

¹ These figures do not include portions of these areas surveyed in preceding years.

TABLE II.—Areas surveyed and mapped in the several States during the fiscal year ended June 30, 1917, and the areas previously reported.

DETAILED.

State or Territory.	Work during 1917 (square miles).	Work previously reported (square miles).	Total.	
			Square miles.	Acres.
Alabama.....	2,582	41,922	44,504	28,482,560
Arizona.....	295	611	906	579,840
Arkansas.....	2,100	9,322	11,422	7,310,080
California.....	1,082	17,201	18,283	11,688,320
Colorado.....		2,809	2,809	1,797,760
Connecticut.....		1,704	1,704	1,080,560
Delaware.....		749	749	479,360
Florida.....	655	9,590	10,245	6,556,800
Georgia.....	2,067	18,157	20,224	12,943,360
Idaho.....		2,191	2,191	1,402,240
Illinois.....		6,770	6,770	4,332,800
Indiana.....	929	9,410	10,339	6,616,960
Iowa.....	1,816	7,764	9,580	6,131,200
Kansas.....		9,016	9,016	5,770,240
Kentucky.....	427	3,241	3,668	2,347,520
Louisiana.....	968	11,468	12,436	7,959,040
Maine.....	225	1,792	2,017	1,290,880
Maryland.....	253	4,581	4,834	3,093,760
Massachusetts.....		1,494	1,494	956,160
Michigan.....	249	5,459	5,708	3,653,120
Minnesota.....	459	4,285	4,744	3,036,160
Mississippi.....	2,417	19,165	21,582	13,812,480
Missouri.....	1,912	25,985	27,897	17,854,080
Montana.....		882	882	564,480
Nebraska.....	3,673	11,588	15,261	9,767,040
Nevada.....		235	235	150,400
New Hampshire.....		1,411	1,411	903,040
New Jersey.....	1,201	3,232	4,433	2,837,120
New Mexico.....		596	596	381,440
New York.....	506	15,246	15,752	10,081,280
North Carolina.....	2,443	23,820	26,263	16,808,320
North Dakota.....	219	11,507	11,726	7,504,640
Ohio.....	1,162	8,296	9,458	6,053,120
Oklahoma.....	848	4,971	5,819	3,724,160
Oregon.....		1,965	1,965	1,257,600
Pennsylvania.....	1,283	13,085	14,368	9,195,520
Porto Rico.....		330	330	211,200
Rhode Island.....		1,085	1,085	694,400
South Carolina.....	661	18,398	19,059	12,197,760
South Dakota.....		675	675	432,000
Tennessee.....	402	8,143	8,545	5,468,800
Texas.....	2,091	24,977	27,068	17,323,520
Utah.....		1,951	1,951	1,248,640
Vermont.....	203	972	1,175	752,000
Virginia.....	884	7,598	8,482	5,428,480
Washington.....	873	7,522	8,395	5,372,800
West Virginia.....	769	13,095	13,864	8,872,960
Wisconsin.....	1,591	12,025	13,616	8,714,240
Wyoming.....		309	309	197,760
Total.....	37,225	408,600	445,825	285,328,000

RECONNOISSANCE.

Alaska.....		31,768	31,768	20,331,520
Arkansas-Missouri.....		58,000	58,000	37,120,000
California.....	9,182	18,218	27,400	17,536,000
Kansas.....		39,960	39,960	25,574,400
Nebraska.....		53,064	53,064	33,960,960
North Dakota.....		39,240	39,240	25,113,600
Ohio.....		41,420	41,420	26,508,800
Pennsylvania.....		41,405	41,405	26,499,200
South Dakota.....		41,400	41,400	26,496,000
Texas.....		92,297	92,297	59,070,080
Washington.....		13,115	13,115	8,393,600
Wisconsin.....		14,425	14,425	9,232,000
Total.....	9,182	484,312	493,494	315,836,160

FERTILIZER INVESTIGATIONS.

The close connection between the problems of the Ordnance Bureau of the War Department and this bureau in increasing supplies of fixed nitrogen and sulphuric acid is at once apparent. The nitrate plant now under construction by the War Department is designed to produce fixed nitrogen for fertilizers in time of peace as well as for munitions in time of war. Cooperation in investigational work between this bureau and the War Department is necessary, therefore, to avoid duplication of effort and the most economical expenditure of both time and money in the disposal of such problems as arise. Such cooperation has been very cordial on the part of the War Department.

Our experimentation in the fixation of atmospheric nitrogen has been largely confined to the production of synthetic ammonia. At the Arlington Farm laboratory apparatus has been installed for experiments with the Haber process, and these experiments have progressed to a point where ammonia has been produced. Optimum conditions of pressure and temperature and the best catalyser have not yet been determined, but after numerous delays, due to inability to secure deliveries of apparatus and materials and to the difficult mechanical problems involved in the process, the work has reached a stage where definite results may be confidently anticipated in the immediate future. This work is being carried on with the active cooperation of the War Department. Germany is producing about one-third of her fixed nitrogen by this process, but so far as is known there are but two installations in the United States for studying the production of synthetic ammonia, one of which is the bureau's plant at Arlington. In these circumstances this work assumes great importance and is being pushed with the utmost vigor. In this investigation the bureau has had the active assistance of physical investigations in the bureau.

In line with this investigation has been the study of the oxidation of ammonia to nitric acid. An Ostwald apparatus was installed and operated to the extent of demonstrating the fact, which has been disputed, that commercial by-product ammonia could be satisfactorily oxidized in this way. The bureau also joined with the Bureau of Mines of the Department of the Interior, the Bureau of Ordnance of the War Department, and a commercial concern of Syracuse, N. Y., in a joint investigation of the problem on a commercial scale. This investigation was carried on in the Semet-Solvay Co.'s plant.

The Ostwald process gives at best a weak acid which must subsequently be concentrated. Moreover, nitric acid is difficult to handle and ship. It seemed advisable therefore to investigate the possibility of securing a nitrate end product instead of nitric acid. This work was carried out at Arlington Farm with complete success. By using the Ostwald reaction chamber and introducing above the catalyzer an excess of gaseous ammonia, a fume of ammonium nitrate was formed which when conducted through an electric precipitator was readily collected as high-grade ammonium nitrate. This salt, in addition to being a concentrated nitrogen carrier for fertilizer purposes, is being very largely used at present as a primary explosive by England.

The possibility of economically oxidizing ammonia to nitric acid by electrolysis was also taken up toward the close of the year, and this investigation is progressing very satisfactorily. Already it has been demonstrated that under certain conditions ammonia may be so oxidized with a very moderate consumption of power.

Other work with nitrogen has included efforts to secure a more complete saving of waste products, such as garbage, by our large cities, and investigations of the problem of inoculating such media as peat with nitrogen-fixing bacteria. While this latter work has opened up some very promising avenues for further research, it has not as yet given results in the way of any large increase of fixed nitrogen.

The bureau's work on phosphates has included several lines of investigation. In cooperation with a commercial concern, a plant on a commercial scale was erected at Hoboken, N. J., to test the bureau's process for producing high-grade phosphoric acid by use of the electric furnace and electric precipitator. This plant was installed by a representative of the bureau and run for several months in practically continuous operation. The results of the test showed the entire practicability of the process for users of pure phosphoric acid and also demonstrated that the operating costs were low enough to make it probable that in the near future the process may be competing with the old sulphuric acid process for acid phosphate production. One private commercial plant to use this process is being erected and several others are in contemplation. A publication giving the results of this work is now in press.

In the effort further to reduce the costs of operation, experiments are now being conducted at Arlington on the possibility of smelting the phosphate rock by means of a hot-air blast instead of electric current, and also on the possibility of using mine-run phosphate rock instead of washed and screened material. From small-scale laboratory experiments both these suggestions seem entirely feasible. Work is also contemplated looking to the recovery of by-products, such as hydrofluoric acid, and the utilization of the slag.

A study of the fluorine content of phosphoric acid, involving new and improved methods of analysis for fluorine, has also been made and published. The regular annual survey of the phosphate industry was also made.

Steady progress is being made in developing American sources of potash, and during the current calendar year approximately one-tenth of our normal consumption will be produced in this country.

The bureau's potash investigations have taken two main lines, namely, the survey of the cement and blast-furnace industries, where potash may be recovered as a by-product, and the work with kelp on the Pacific coast. During the year a complete survey of the cement industry of this country and Canada was made to determine with some degree of accuracy the amount of potash being volatilized and lost at cement mills. Samples of raw mix and finished cement were secured from all mills having 100 barrels capacity or over and analyzed for potash. Knowing the ratio of raw mix to finished cement and the producing capacity of each mill, it was possible to calculate accurately the amount of soluble potash being lost. This study demonstrated that with suitable collecting apparatus the cement mills of this country might produce approximately 70,000

tons of actual potash annually. Slight modifications of operating practice would increase this total to at least 100,000 tons. A bulletin giving the results of this work is now in press.

A similar survey of the blast-furnace industry was begun and is now in progress. In this work the Bureau of Mines is cooperating to the extent of assisting in the collection of samples.

The appropriation for an experimental kelp plant became available in August, 1916, and shortly thereafter work was actively begun. Difficulty was found in securing deliveries of the necessary materials and machinery, but by the end of the fiscal year the plant was practically completed and ready for operation.

The plant as it stands includes a 115-ton self-propelled harvester; wharf with 600-foot conveyor; derrick with grab bucket for unloading kelp from the harvester; a transformer house containing electric operating equipment; chopper and receiving bin; storage bins of 300 tons capacity; drier house containing three 50-foot rotary driers with dust chambers, blowers, conveyors, and motors; four 25-foot retorts for distilling the dried kelp, with storage bin above and discharging apparatus; gas line from retorts with burners, valves, tar, and distillate seal and receiving vat; four air lines from blowers to furnaces; a millhouse with storage bins for char with conveyors and grinding, sacking, and leaching apparatus, and vat for brine; a machine shop and equipment; an office building; and a 10,000-barrel storage tank for fuel oil, with pipe lines to driers.

Under construction is an evaporator house to contain evaporator, crystallizer, salt traps, preheater, vacuum pump, condenser, receiving vats, storage bins, vapor and brine lines, and boiler. This equipment has all been contracted for and some of it delivered.

Much of the equipment entering into the plant has been secured second hand at a substantial reduction over current prices for new material, and economy in construction has been practiced wherever it was possible without sacrificing efficiency. In this way it has been possible to construct the plant for less than \$100,000 instead of the original estimate of \$150,000, despite the high cost of labor and materials. Of the original appropriation of \$175,000 there remains sufficient for operating expenses during the current fiscal year, unless unforeseen expenditures should become necessary. Active operations will begin in a few weeks, as soon as the new kelp growth is available.

In connection with the erection of the plant, studies of the life history of the kelp have been made and much information having a direct bearing on the use of kelp commercially has been secured. It seems likely that there is an annual dying of the kelp in southern California waters, followed by an immediate new growth. Certainly this year there has been extensive dying back of the kelp, and many of the heavier beds have disappeared temporarily. These are, however, now recovering rapidly through new growth, and operations will not be long retarded from this cause.

During the year the bureau has received a large number of samples of supposed fertilizer materials for analysis, and a large body of correspondence on fertilizer matters has also been handled. Both these activities have been materially increased by the general interest in fertilizers, owing to the prevailing high prices, the short supply of many important ingredients, and the unusually heavy demand.

CHEMICAL INVESTIGATIONS.

At no time in the history of the bureau has there been so great a demand made on the laboratories devoted to the chemical investigation of soils for the examination of samples as during the past year. This has been due, no doubt, to the increased interest in the stimulation of greater crop production brought about by war conditions. This increase of routine work has come both from individual farmers who have sought advice regarding liming, fertilizing, or cultural treatment of soils, in which case work was undertaken only when it was thought some laboratory examination would be of value to farmers generally, and from other bureaus of the department and other departments of the Government where the same interest in greater crop production has brought about an increased demand for work of this nature.

Such time as could be spared from routine work has been devoted to investigations chiefly along two lines—the inorganic composition of soils and the liming of soils. In connection with the former, work has been continued on a study of the composition of the water extract of soils and important and interesting results obtained, and in cooperation with the soil survey progress has been made toward determining the composition of samples of virgin soils of more important soil types.

In the investigation of the liming of soils results have been obtained that throw light on the character of soil acidity and will tend to make it possible for the practice of liming to be carried on in a more intelligent manner.

SOIL PHYSICS

Owing to unusual conditions due to the war a large part of the time and force of the Physical Division has been employed in co-operating with the Division of Fertilizer Resources. Assistance has been furnished especially in solving the physical and mechanical problems involved in the preparation of synthetic ammonia by the Haber process and in the oxidation of ammonia in solution by electrolytic means.

Investigations on the excessive erosion of soils have been continued and the physical properties of soils subject to erosion determined. The movement of water in soils has been investigated and a comparison made of the methods for determining the critical moisture content. The relation of absorbed moisture to the critical moisture content has been studied. The effect of temperature changes on the physical condition of the soil is being studied. The colloidal condition of clay soils has been investigated to determine the cause of high degree of stickiness in such soils. Systematic study of the physical properties of important soil types has been undertaken.

In addition to these lines of work the usual mechanical analyses of soil samples collected by the Soil Survey have been made, and an unusually large number of samples for other bureaus have been analyzed during the year. One machinist also has been continuously employed in the construction of unusual pieces of apparatus and in the repair of instruments for the bureau.

REPORT OF THE ENTOMOLOGIST.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., Aug. 1, 1917.

SIR: I submit herewith a report of the work of the Bureau of Entomology for the fiscal year ended June 30, 1917.

L. O. HOWARD,
Entomologist and Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WORK ON THE GIPSY MOTH AND BROWN-TAIL MOTH.

The work of preventing the spread of the gipsy moth and the brown-tail moth, under the direction of Mr. A. F. Burgess, has been continued along the same general lines as during the preceding year, but many improved methods have been adopted. The territory infested with the gipsy moth showed less defoliation than heretofore, and as a result of the scouting and extermination work carried on along the outside border there has been a decrease of 98 square miles in the total infested area.

The brown-tail moth infestation has decreased, not only in area but in severity. The area that has been found uninfested and that has been eliminated from quarantine this fiscal year amounts to 171 square miles. No new colonies of the gipsy moth or brown-tail moth outside of the area known to be infested have been reported during the past season.

The field operations have been improved, and the purchase of additional spraying equipment has made possible thorough treatment of most of the heavy infestations in the territory adjoining the border towns. The results of the spraying of the previous year were excellent, as in the spots actually treated few egg clusters of the gipsy moth were deposited. A new method of banding trees has been adopted, and a tree-banding material prepared by this bureau in co-operation with the Bureau of Chemistry has been used on a large scale with excellent results. The use of this material has resulted also in decreasing the cost of banding trees, so that a considerable saving has been effected. In order to prevent the spread of small gipsy-moth caterpillars from bad infestations inside the border to towns that were slightly or not at all infested, operations have been carried on in a large number of towns well inside the border, and

hilltops and exposed areas from which spread by wind was most likely to occur have been given special attention.

STATE RELATIONS AND COOPERATION.—In order to avoid duplication of effort and obtain the best results, arrangements are made in advance with the different States where infestations exist. In general the field operations of the bureau, with the exception of the parasite and quarantine work, are conducted along the extreme border of infestation, and the State work is carried on in the inside territory, which is infested more heavily.

The places where colonies were discovered in previous years in New York, New Jersey, and Ohio were scouted thoroughly but during the winter no egg clusters were found. With the exception of one place at Mount Kisco, N. Y., which is in territory that is very difficult to handle, all the gipsy moths outside of New England apparently have been exterminated. The Mount Kisco place will require more work, and this is being done in cooperation with the State of New York. It probably will be necessary to make one more thorough examination of all these outside places to make sure that no insects are present.

QUARANTINE WORK.—The number of shipments of nursery stock, forest products, and Christmas trees and greens from the infested areas to points outside has increased materially. The demand for these products has been much greater than heretofore, and more than 42,000¹ shipments have been inspected and certified. The percentage of gipsy-moth infestations found on these products was about the same as during the previous year; although a larger proportion of the shipments of Christmas trees and greens was found infested. The number of brown-tail moth webs obtained in this way was much less than the number reported during the previous year and showed a greatly decreased infestation. The inspection of trains at several of the principal junction points was continued, but only 78 brown-tail moths were destroyed on or in cars during the season. This number was so small that it has been deemed advisable to discontinue this kind of inspection during the coming year.

SILVICULTURAL WORK.—The examination of the sample plats has been continued, and marked changes have been noted in most of these areas. This is an experiment, however, in which several years must elapse before definite results can be obtained. Reports have been prepared relative to the best method of handling certain types of woodland, and a careful study is being made of the cordwood market in New England for the purpose of determining, if possible, whether more cordwood can be disposed of to the advantage of the owner of moth-infested woodland.

EXPERIMENTAL WORK.—The experimental work has been continued along most of the lines previously reported. A careful investigation is being made of the gipsy moth as a cranberry pest and of the best methods for handling the insect under cranberry-bog conditions. It is found that this insect is capable of causing very serious injury to the cranberry crop, and although confined to a somewhat limited area the cranberry industry is of vital importance to the people living in that district.

¹ July 1, 1916, to June 1, 1917.

Experiments relating to the spread of the gipsy-moth larvæ by the wind have been continued, and many special tests have been made to determine the amount of spread in certain selected areas, as this information is very useful in planning the field work.

Experiments with different materials for banding trees are under way and the new tree-banding material that is being used is the result of some of the experimental work already conducted.

The development and improvement of high-power spraying machines has been given considerable attention, and the three new motor-truck sprayers recently acquired are a vast improvement over any of the spraying outfits used heretofore.

Careful studies are being made of the means by which the female gipsy moth attracts the males, in order that this information may be used to advantage in the field work. The sense organs of the caterpillars are being studied in connection with the tree-banding and other insecticide work in order that more knowledge may be obtained as to the exact effect of repellents in control work.

A study of the increase or decrease of the gipsy moth in the field in selected localities has been continued, and special information as to the principal factors that bring about decrease in the field under normal conditions is being obtained. An investigation of the effects of temperature and humidity, both on the insects themselves and on the increase of their parasites and natural enemies, including diseases, is being continued.

PARASITE AND DISEASE WORK.—Careful studies are being made of the increase of the introduced parasites under field conditions in different localities. All the species previously reported as having become established have been found to occur in greater numbers than ever before. Several species that previously were known to have established themselves but had not increased to any great extent have been found in considerable numbers. Among these should be mentioned *Blepharipa scutellata*, one of the tachina-fly parasites of the gipsy moth, and two others, *Parexorista chelonias* and *Zygobothria nidicola*, which attack the caterpillars of the brown-tail moth.

The effect of parasites has been more noticeable than usual. Colonization has been limited to a few species that have not become distributed over the entire infested area. During the fall of 1916 more than 2,500,000 individuals of *Schedius kuwanae* were liberated, and in the spring of 1917 about 8,500,000 individuals of *Anastatus bifasciatus* were colonized in the New England States. Of *Apanteles melanocelis*, 5,500 individuals have been colonized in the field.

Work on the wilt disease of the gipsy moth has been continued both in the laboratory and in the field, and progress has been made in clearing up some of the obscure points concerning this organism. It has been shown conclusively that this disease may be distributed by insects whose habits bring them in contact with affected caterpillars.

A new caterpillar disease of the gipsy moth is being studied systematically and has proved to be very destructive to caterpillars under laboratory conditions. An attempt is being made to study its behavior under field conditions, and numerous experiments are being carried on to determine its value in this country. The disease is prevalent in Japan.

DECIDUOUS-FRUIT INSECT INVESTIGATIONS.

Investigations of deciduous-fruit insects have been carried on under the direction of Dr. A. L. Quaintance, as formerly.

APPLE INSECTS.—The studies carried on during the past few years on aphids affecting apples have been fairly well completed, and publications have been issued concerning the majority of them. The extensive tests for some time in progress in the use of certain poisonous gases against the woolly aphid on the roots of orchard trees have been completed. Although several substances were found effective against the insects, more or less injury to the trees resulted in many cases. Further experimentation is planned with other fumigants.

The life-history studies of the roundheaded apple-tree borer are well advanced. Field observations confirm the importance of the destruction of certain native forest shrubs in which this insect breeds principally. A related insect, the spotted apple-tree borer, has been found to be a serious enemy of apple trees in portions of Michigan.

The codling-moth observations have been continued. Biological studies in the Grand Valley of Colorado, in cooperation with the Colorado Agricultural Experiment Station, have been completed. Experiments in orchards, to perfect a spraying schedule for Colorado conditions and to determine the value of sprays for the control of this insect in arid regions, are being continued. Further tests of the automatic codling-moth band trap mentioned in my last report indicate the usefulness of this apparatus as an adjunct in the control of the pest, especially in regions where the insect is excessively injurious. Studies of this insect are being continued in the Pecos Valley in New Mexico, where a special effort is being made to determine the comparative effectiveness of dust and liquid sprays. Tests of poison dust compared with poison sprays are also in progress in the Shenandoah Valley of Virginia.

GRAPE INSECTS.—A comparatively new grape pest has attracted attention in California, namely, the grapevine mealybug, and at the request of vineyardists a specific study of this insect has been begun at Fresno. Thorough investigation of the life history is in progress, and extensive tests of sprays and other remedies are under way.

The large-scale spraying experiments against the grape-berry moth, in progress in vineyards in northern Ohio, in cooperation with the Ohio Agricultural Experiment Station, were completed successfully. They confirm the earlier results obtained at North East, Pa., which showed that this pest can be controlled by two thorough applications of arsenate of lead (preferably in Bordeaux mixture) made by the "trailer" method, the first immediately after the falling of the blossoms and the second two weeks later. This is an important improvement over schedules requiring the late applications of sprays, which usually result in discolored fruit at picking time. A largely increased vineyard acreage in northern Ohio now is being sprayed under the direction of the bureau.

PEACH INSECTS.—Additional information has been obtained concerning the life history and injuries of the peach borer, and much work has been done with various fumigants in the effort to destroy the borers at the base of the trees. It has been shown that carbon disulphid, even in minimum doses, may cause more or less injury to

peach trees under certain weather and soil conditions, and no method has been found as yet to safeguard entirely the fumigation process. A number of other fumigants are being tried in the hope that an effective and safe one may be found.

Work has been done with dust sprays in the control of the plum curculio. In cooperation with the Bureau of Plant Industry, experiments are being conducted at Fort Valley, Ga., with powdered arsenate of lead and finely ground sulphur in comparison with arsenate of lead in the self-boiled lime-sulphur solution as a combination treatment for curculio, peach scab, and brown rot.

In the fall of 1916 a new and serious enemy of peaches was found near Washington. It is a small larva which bores into twigs and fruit. This insect has been found also in New Jersey, on Long Island, and at one or two other points in New York State. It is new to science, but correspondence has shown that it came from Japan, where it has been known for 10 years or more. It may be called the oriental peach moth, and has been named scientifically *Laspeyresia molesta* Busck. A careful study of the biology of the insect is under way, and experiments are being made with control measures at the Arlington Experimental Farm. Extensive warnings have been sent to fruit growers.

NUT INSECTS.—Extensive work on insects injurious to the pecan has been carried on at Monticello, Fla., and several reports are now in preparation. A Farmers' Bulletin (No. 843) on the insect enemies of the pecan is now in press.

From headquarters at Paxinos, Pa., careful studies on chestnut weevils have been made. Fumigation to destroy the grubs in newly harvested nuts has been planned, and if possible central depots, where fumigation work can be handled on a community basis, will be established in the chestnut-producing territory.

CRANBERRY INSECTS.—Headquarters for the work on insects injurious to the cranberry have been changed from Brown Mills to Toms River, N. J. Some progress has been made in the control of the blackhead fireworm on bogs that can not be reflowed, although the work is still in the experimental stage. Some growers, at the suggestion of this bureau, are using nicotine sulphate with apparent success. The cranberry tipworm is being studied, and control measures, such as sanding, reflowing, and spraying, are being tested. Sanding promises to be effective in the control of this insect, although many growers claim that sanding increases troubles from fungous diseases. A Farmers' Bulletin (No. 860) dealing with cranberry-insect problems is in press.

NATURAL ENEMIES OF FRUIT INSECTS.—Much progress has been made in the study of the life histories of various species of parasitic and predacious insects that feed upon the principal fruit pests, and special attention has been paid to the fungous diseases of such pests as well as of other species. An interesting disease of cutworms has been found, and, so far as it has been tried, all species of cutworms seem susceptible to inoculation with it.

ORCHARD INSECTICIDES AND SPRAYING MACHINERY.—Further tests of insecticides developed in the bureau have been made, alone and in combination with fungicides. In cooperation with the Bureaus of

Chemistry and Plant Industry, studies of the poisonous spray residues on fruits are being continued, and this investigation probably will be completed during the summer of 1917. An investigation of the effect on bees of spraying apple trees with arsenicals when they are in bloom and after the falling of most of the petals has been practically completed and will furnish the basis of a report in the near future. Insecticidal constituents of plants have been studied in cooperation with the Bureau of Plant Industry. Additional poisonous plants have been obtained, and their toxicity and physiological effects on insects are being determined. In view of certain surprising results obtained from the use of nicotine for the control of the codling moth in the Northwest, a special study in laboratory and field is being made to determine the possible action of this substance on the eggs and larvæ of this insect. Studies of the comparative effect of pyrethrum, hellebore, and sabadella on insects are well advanced, and experiments with a very promising product, one of the so-called fish-poisons, presumably "Derris," are being made.

INSECTS ATTACKING NURSERY STOCK.—Thorough tests of fumigants and other substances in the destruction of the woolly aphis on the roots of nursery stock failed to give results of much practical value because of the injury to the plants.

It has been found that by the use of 40 per cent nicotine sulphate at the rate of 1 part to 1,600 parts of dilute lime-sulphur solution, 95 per cent of the nymphs of the first brood of the apple leafhopper can be killed. Nymphs of the second brood, however, are more hardy.

SOUTHERN FIELD CROP INSECT INVESTIGATIONS.

Dr. W. D. Hunter has been in charge of the southern field crop insect investigations of the bureau as in previous years.

COTTON INSECTS.—The boll-weevil investigations conducted at Tallulah, La., consisted of field tests of various control measures and additional studies on the habits of the weevil. Extensive studies on the picking of weevils and squares have shown that owing to the very slight beneficial effect obtained and the large amount of labor required this can not be recommended as a control measure. Studies of the "bag-and-hoop" as a means of collecting weevils and squares showed that this treatment was so injurious to the plants that an actual loss in cotton production was caused by its use. Very interesting and important results were obtained from the poisoning experiments. It was found that the use of certain arsenical insecticides late in the season resulted in uniform increases in production, amounting in some cases to several hundred per cent. Laboratory studies were conducted to give additional data on the use of these insecticides as a basis for more extensive field work in the future. The cotton-spacing studies were continued to determine the relation of the various spacings to the degree of weevil infestation, and it was found that under Mississippi Delta conditions a spacing of about 18 inches in the drill gives the best results. Special studies were conducted on the relation between the characteristics of various cotton varieties and weevil injury. It is hoped that sufficient data may be

gathered so that varietal characteristics may be correlated with conditions in the different localities, thus permitting the designation of certain varieties as best for each type of conditions.

Hibernation studies were continued to determine whether the ability of the weevil to withstand cold is increasing and to settle related questions. In this connection regular surveys have been instituted with a view to the development of a system of predicting the extent of weevil emergence each spring. A number of so-called weevil remedies were tested at the request of the inventors and all found worthless. A number of mechanical collectors of weevils also were tested and found to be of little or no value.

A cotton-insect laboratory was established at Thomasville, Ga., in cooperation with the Georgia State Board of Entomology, for the study of the various insects that attack the cotton plant in that section. This project is of special importance on account of the difficulties in producing sea-island cotton with the boll weevil present. Another study dealt with the rôle insects play in the transmission of cotton diseases. The experiments have shown very definitely that insects are agents in the transmission of certain cotton diseases, and this throws considerable light on the control of these diseases.

A laboratory was established in the Imperial Valley in California for the investigation of cotton pests, several of which threaten to assume important proportions.

As in other years, the advance of the weevil was determined, and a map was issued in September, 1916, showing the new territory invaded.

TOBACCO INSECTS.—The investigations relating to tobacco insects at Clarksville, Tenn., have been confined principally to the tobacco hornworms, the mosaic disease, the tobacco beetle, tobacco cutworms, and miscellaneous insects.

Field experiments and observations upon remedies for the control of tobacco hornworms were conducted in 11 counties in Kentucky, 3 in Tennessee, 2 in Virginia, and 2 in North Carolina. In all, 156 experiments with arsenate of lead were made by agents of this bureau, and records of 244 applications of arsenate of lead and Paris green by the farmers were obtained. It was found that the farmers were obtaining practically twice as good results with arsenate of lead, which in many cases they had applied for the first time, as with Paris green, which they had been using for years. The records showed also that results obtained by the farmers were not as good as those obtained from applications made by agents of the bureau. On large tobacco a 4-pound application of arsenate of lead has been found to be sufficient, unless a considerable number of eggs are present, in which case it is necessary to apply 5 pounds in order to keep the tobacco free of worms for a week or ten days. It was determined, further, that on account of the small spread of the tobacco plants in the more eastern States an application of 3 to 4 pounds will be as effective in certain regions of Virginia and North Carolina as one of 4 to 5 pounds in Tennessee and Kentucky.

Further improvements in machinery for the application of arsenate of lead have been made, as the results of suggestions by agents of the bureau.

As a result of work at Quincy, Fla., the method of combating the tobacco budworm by means of the arsenate of lead and meal mixture has been perfected and this remedy now is used very generally. It has effected a saving of at least \$20 per acre over the method previously in vogue.

It has been found that the tobacco thrips can be controlled fairly well by the use of nicotine sulphate as a daytime spray. Heretofore planters in Florida have had to use kerosene emulsion for the control of this insect and could make the application only at night. By using nicotine sulphate planters can employ their labor more efficiently and obtain practically as good results as usually were obtained by applications of kerosene emulsion at night.

INSECTS AFFECTING SUGAR CANE.—Work on sugar-cane insects was conducted on lines previously established. Experiments on control, general observations, and life-history studies were continued. A more efficient machine was devised for the application of poisons to sugar cane. A search was made for parasites of the sugar-cane moth borer in the Southeastern States and in Cuba. As a result of the work in Cuba many individuals of one species were shipped to Louisiana. Whether they have become established can not be determined at this time. Methods of controlling the Argentine ant in sugar fields were tested but on the whole the results were unsatisfactory and considerable further work is necessary.

INVESTIGATIONS OF INSECTS AFFECTING THE HEALTH OF MAN.

The agricultural importance of malaria is shown by the fact that the loss from this disease on a typical southern plantation cultivating 1,800 acres of land amounted during one season to \$2,200 through loss of time and to \$4,300 through inefficiency due to the infection.

Four species of mosquitoes of the genus *Anopheles*, namely, *quadrimaculatus*, *punctipennis*, *pseudopunctipennis*, and *crucians*, have been encountered in the delta region of the lower Mississippi Valley where the field work of the bureau is conducted. Intensive studies on abundance and house habits showed that *Anopheles quadrimaculatus* is the principal species concerned in the transmission of malaria in this region.

Large series of specimens were reared for experiments conducted in New Orleans to test the resistance of the malaria parasites to low temperatures while in the body of the mosquito. This work showed that the tertian parasite is able to survive a temperature of 31° F. for a period of four days. In a smaller series of tests the estivo-autumnal parasite survived a temperature of 35° for 24 hours. This work is preliminary to more detailed investigation to determine the possibility of the malaria parasites surviving the winter months in the body of the mosquito host. A long series of dissections of adult *Anopheles* collected during the winter about habitations gave no evidence of infection.

Bearing on the question of infection in the mosquito host is the food habit of the adult *Anopheles*. An examination of nearly 5,000 stomachs of *Anopheles quadrimaculatus* at Scott, Ark., during the

active summer season showed that less than 50 per cent had taken a blood meal, and, of those that had, only 20 per cent had fed upon human blood. It appears from this work that the great reduction in the abundance of *Anopheles* with the advent of the colder temperatures of fall operates against the infection of the mosquitoes that enter the more inactive period of winter.

A survey of malaria cases and infection on a plantation, in relation to sources of *Anopheles* and environmental conditions that favor concentration about habitations, showed that, even within the limits of a single plantation, the location of the houses in respect to breeding places of *Anopheles* has an important influence on the number of cases of malaria. Where drainage is not possible in the delta country it has been found practical to impound the surface water in a portion of a bayou under conditions unfavorable for the development of *Anopheles* larvæ, thus creating a favorable zone for the location of cabins for the tenants.

Cooperation with various agencies interested in the reduction of malaria has been continued. The Bureau of Fisheries has made progress in the study of fish that feed upon mosquito larvæ.

The work on the control of the house fly was continued at the Bethesda, Md., Experiment Farm of the department through experiments with manure pits with flytraps attached. A practical type of manure pit was devised. The experiments with maggot traps in cooperation with the Maryland Agricultural College were completed.

Many experiments with certain common baits were carried out, with the result that much more exact information has been obtained as to the stage of fermentation most attractive to flies and the length of time each remains attractive. Some progress was made in the study of the reactions of flies to pure isolated chemical compounds. Poisoned baits made with sodium arsenite, calcium arsenite, and formalin were tested and compared.

Further observations and experiments on the overwintering of house flies lead to the conclusion that in the latitude of Washington, as well as farther south, the house fly overwinters in the larva and pupa stages. The fly was found also to breed continuously during the winter in heated buildings, such as houses used for breeding of guinea pigs, where there was food for the adult flies and materials on which the eggs could be laid and in which the larvæ could develop. Exact data were obtained on the seasonal occurrence of certain common flies. Studies were made on the life history and habits of the cluster fly, which is often a nuisance in houses, and trapping as a control measure was tried.

The work on the eradication of the Rocky Mountain spotted-fever tick was continued successfully in Montana in cooperation with the State board of entomology. Many observations were made on biting flies and other insects of importance in connection with the health of man, local outbreaks were investigated, and a special circular on important insects which may affect the health of men or animals engaged in military operations was printed in a large edition.

A special feature of the work was the completion of a large monographic treatment of the mosquitoes of North and Central America and the West Indies, published by the Carnegie Institution of Washington.

INSECTS AFFECTING THE HEALTH OF DOMESTIC ANIMALS.

Work on insects in relation to packing houses and abattoirs has been continued throughout the year. These investigations are carried on cooperatively with the Bureau of Animal Industry and the work was devoted especially to the problem in connection with the establishments operated under the meat-inspection service. Attention has been given to the improvement of construction and arrangement of equipment about packing establishments in order to prevent permanently the formation of suitable breeding places for flies. Investigations of methods of destroying larvæ in various breeding media which can not be readily prevented from becoming infested have been continued. Further progress has been made in the destruction of adult insects by means of traps and poisoned baits.

In connection with this investigation the fact developed that many flies assembled in the vicinity of slaughter houses, even though no breeding places were present on the premises. This suggested the need of studies on the flight of the several species of flies that are of more or less importance. Preliminary experiments indicate that both meat flies and the house species fly considerably farther than has been supposed.

The extensive use of screen-wire cloth for the protection of food throughout the country, and the lack of knowledge concerning its durability and its efficiency in protecting man, led to a series of tests to determine the fineness of mesh necessary to exclude various insects, and other tests to determine the relative durability of various kinds of screen in different climes.

Work on the screw-worm fly has been continued. The proper destruction of carcasses of animals is the most important step in control, and methods of carcass disposal have been given further attention. The relationship between climatic conditions and severe outbreaks of this insect is very intimate and is receiving attention. The more important findings obtained in the course of the work on this project have been prepared for publication as Farmers' Bulletin 857.

The work on horseflies has been expanded by placing an agent in the field in Nevada and California to conduct investigations in cooperation with the Nevada Experiment Station. Although this work was begun rather late in the season, satisfactory progress has been made looking toward the determination of the breeding places and habits of the several species that are of considerable importance to the live-stock industry there. The work in southwestern Texas on this project has progressed satisfactorily, but the habits of insects of this group render their control very difficult.

Work on the biology of the common ox warble of the United States (*Hypoderma lineatum*) has been continued and some findings have been made which doubtless can be utilized in control work. Further attention has been given to the question of the distribution, abundance, and injuriousness of the two species of warbles occurring in this country. The experiments in controlling the ox warble by extracting the grubs from the backs of cattle on individual farms have been continued.

Much valuable information has been obtained on the life history and habits of the three species of horse bots that occur in the United States, and the data, with suggestions for control, have been prepared for publication. A nose protector for horses, which appears suitable for preventing infestation by the bots, has been developed in the course of the work. The nose fly, which has been given special attention, is continuing to spread southward and eastward. Its recent distribution has been mapped.

Further work on the common chicken mite and various species of lice on poultry has been carried on with the view of making the results more uniformly successful and reducing cost of treatment. In addition to studies of the poultry parasites that are most frequently the subject of complaint, work has been done on the depluming mite and certain other mites that cause more or less local trouble. What appear to be very satisfactory methods of control have been found.

The use of sodium fluorid proved so successful against chicken lice that experiments were conducted to determine its effect on lice of horses, cattle, and other domestic animals. The use of this material, either in liquid or dry form, was found very satisfactory, but its greatest advantage will accrue from the fact that it can be used in dust form during the winter months, when the dipping of live stock is objectionable.

CEREAL AND FORAGE INSECT INVESTIGATIONS.

In the last annual report the death of Prof. F. M. Webster, who organized this section of the bureau's work, was announced. In March, 1917, Mr. W. R. Walton was placed in charge.

GRASSHOPPERS.—Two severe outbreaks of grasshoppers, involving many hundred thousands of acres, occurred during the early summer of 1917 in California and western Montana. In the latter State much of the territory involved was Indian land, on the Flathead Reservation, and for this reason the Bureau of Indian Affairs appropriated the sum of \$1,000 for the purpose of providing material and labor in poisoning the grasshoppers. Two expert entomologists from this bureau were detailed to work in an advisory capacity in cooperation with the States Relations Service and the State authorities. Good progress has been reported in eliminating this outbreak. In California the outbreak was more general in character, involving to a greater or lesser extent the following counties: Humboldt, Glenn, Butte, Colusa, Yuba, Nevada, Contra Costa, Merced, Tulare, San Diego, Imperial, and Stanislaus. Two experts, one of them engaged expressly for this purpose, acted in cooperation with the State extension workers in combating the outbreak. Investigations were conducted with the view of reducing the cost of poisoned baits and utilizing such insecticides as are most available during the present emergency.

HESSIAN FLY.—The great general outbreak of the Hessian fly that occurred throughout the United States during the years 1914–1916 has abated very perceptibly, excepting in eastern Kansas, where serious infestation of the 1917 crop threatens severe injury to the winter-

wheat crop of 1918. At this writing steps are being taken to induce the wheat growers to plow down their 1917 stubble immediately after harvest, to destroy all volunteer grain, and to plant their wheat this fall at the fly-free date, as indicated by the entomological staff.

In southeastern Nebraska, southern Illinois and Indiana, and parts of Missouri the fly is present, but not in alarming abundance.

Some injury to wheat in central California occurred during the spring of 1917. Special intensive investigations of the Hessian fly are in progress in Illinois, Kansas, Nebraska, and Missouri. Probably it will be necessary to carry on these investigations for several years before full results can be expected from them.

CHINCH BUG.—Owing to favorable hibernating conditions during the past fall and winter in Texas, Kansas, and Illinois, a chinch-bug outbreak of considerable extent and severity seemed inevitable during the early spring of 1917, but owing to extraordinarily heavy precipitation that occurred during the critical period of the egg-hatching season the situation has improved very materially throughout the infested region. An illustrated poster giving advice for the destruction of the bugs has been issued and distributed throughout the infested area.

WHITE GRUBS.—A large flight of May beetles, well known as the parents of the white grubs, occurred throughout Illinois, Wisconsin, Michigan, Ohio, Pennsylvania, New York, New Jersey, and parts of other Northern States during the month of June, 1917. The flight consisted of two sections, designated as "Brood A" and "Brood C." The occurrence of this flight means that throughout the area affected the white grubs will be destructively abundant in 1918, which will be the second year in the life of the resulting progeny. An illustrated poster giving methods of control has been distributed throughout the region most badly infested by the white grubs.

ALFALFA WEEVIL.—The alfalfa weevil has invaded the Pacific slope. The spread of the weevil has been slow and uniform, regardless of the character of the country, whether cultivated or wild, and all evidences indicate that it may continue to spread in the same manner. One of the most common means of distribution is through the movement of infested alfalfa hay, but the insects have been found also in clothing worn on trains or carried in trunks.

Several more or less satisfactory means of controlling the weevil have been discovered and are being used extensively. These consist of flooding the fields so as to cover them with sediment; spraying with arsenicals in the spring and between cuttings; progressive pasturing; and harrowing the fields when they are in a dry condition, in order to produce something resembling a dust mulch, which kills the insects.

The European parasites of the weevil have continued to increase; as high as 30 per cent of the weevil larvæ present in midsummer were found to be parasitized. These parasites now have spread throughout the Webber Valley from 10 to 30 miles from the original point of introduction.

CORN EARWORM.—A rather severe outbreak of the corn earworm occurred during the latter part of May and the early part of June,

1917, in South Carolina, Georgia, and Alabama. The caterpillars first attacked fields of hairy vetch and then, after completely stripping this crop, migrated to cotton. A remarkable phenomenon observed in this connection was the unusual color and variability of the markings of the tubercles in the caterpillars. So markedly changed was their appearance as to deceive experienced entomologists and lead them to suppose that an unknown pest had appeared. The earworm has proved amenable to the usual remedies.

RANGE CATERPILLAR.—During the summer of 1916 the range caterpillar appeared to have decreased so greatly in numbers that it was deemed advisable to reduce considerably, for the time being, the force of investigators detailed to this project. The cause of this decrease is somewhat obscure, but it may be due to the work of the natural enemies that have been introduced artificially in great numbers and become established in portions of the area infested. A survey is being made during the summer months of 1917 to determine the future necessities of the investigation.

INSECTS AFFECTING THE PRODUCTION OF CLOVER SEED.—An extensive investigation of the insects affecting clover-seed production is in progress in the Pacific States. The clover-flower midge in the Pacific Northwest has proved amenable to the same methods of control that have been recommended and used in the Eastern States for many years, and the clover growers in the Northwest are adopting the methods recommended by the experts in charge of State and Federal stations.

The clover root-borer, which is numerous in Oregon and Washington, has been made the subject of a special investigation to determine its powers of flight, as affecting its distribution. Further progress has been made in the control of the clover-seed chalcis.

EMERGENCY WORK.—In order to meet the emergency caused by the war and the diminution in cereal crops throughout the United States several special publications giving specific advice, most of them in the form of posters or post cards mailed directly to the growers most interested in the various cereal crops, have been prepared and widely distributed. A Farmers' Bulletin (No. 835) has been published summarizing briefly the methods necessary for the detection, elimination, and control of the principal insects, such as the Hessian fly, chinch bug, army worm, cutworms, grasshoppers, white grubs, billbugs, wireworms, and the corn root-aphis, which affect cereal crops.

INVESTIGATIONS OF INSECTS AFFECTING FOREST AND SHADE TREES, FOREST PRODUCTS, AND HARDY SHRUBS.

The branch of Forest Insect Investigations has continued under the supervision of Dr. A. D. Hopkins and has been conducted with special reference to the working out of the seasonal histories of the insects and to the determination of the effect of climatic conditions on their distribution and periodical activities, and the principles underlying prevention and control of their outbreaks and injuries.

The *Dendroctonus* barkbeetles have continued to be a menace to the standing pine, spruce, and Douglas fir timbers of the Rocky Mountains and Pacific slope wherever control measures have not been adopted and carried out to prevent the spread of local outbreaks, and in the aggregate many millions of dollars' worth of the best timber has been lost. Wherever the methods that have been determined and advised by this bureau have been adopted and carried out, most gratifying results have followed. Especially is this the case in and adjacent to areas in Colorado, Montana, Wyoming, Oregon, and California where control work has been done in past years.

The work that has been done in the Yosemite National Park during the past three years has resulted in almost complete elimination of these barkbeetles in the yellow-pine and sugar-pine areas. Some of the private owners of large areas of pine timber in California have made an earnest appeal for aid in protecting the timber from the continued and apparently increasing depredations by these beetles. This has resulted in a general understanding between the representatives of the Bureau of Entomology and the Forest Service of this department, the National Park Service of the Interior Department, and representatives of a number of private owners by which a survey of the timbered areas of a large part of the State of California is to be made, under the supervision of a representative of this bureau, to determine the character and extent of the depredations and obtain data on which to base recommendations for concerted control operations.

The work on Long Island, N. Y., against the hickory barkbeetle in the hickories and the two-lined chestnut borer in the oaks, which was completed during the fall of 1916, apparently has resulted in a great reduction in the numbers of these two insects, which were a menace to the hickories and oaks of the island.

The oak shade and forest trees of the Southern States have suffered severely from the attack of the *Romaleum* oak borer in the main trunks and the *Prionus* root borer in the roots. Special investigations and experiments carried on during the year have resulted in the determination of many new facts relating to these two insects and of methods for protecting the trees against their destructive work.

The damage to buildings and forest products by termites, or white ants, has attracted much attention, and the methods of protection that have been determined and advised have been adopted in many cases with excellent results.

The damage to forest products by powder-post beetles has been diminished greatly within recent years through the adoption of the methods recommended in publications and correspondence. One of the greatest losses from this class of insects occurred a few years ago in the Army and Navy stores of lumber, oars, handles, tent poles, etc., but since the methods of control and prevention were advised no further complaint has been received of serious damage.

Heretofore extensive plantations of black or yellow locust have been a failure on account of the locust borer. Experiments carried on during the spring of 1917 with several insecticides, including some new formulas, sprayed on the bark before the young borers

had entered the wood, resulted in the killing of 80 to 90 per cent of the larvæ. This indicates quite conclusively that a comparatively inexpensive treatment during the early stage of the growth of the trees will serve to protect the plantations from serious damage.

The percentage principle of controlling *Dendroctonus* beetles has stood the test of another year and appears to be one of the most important practical results of the investigations of this branch. The timber of the areas in which it has been applied during the past ten years has continued in a healthy condition.

Continued investigations by Dr. Hopkins of the relation of latitude, longitude, and altitude to the periodical activities of insects and their host plants have resulted in rapid progress toward the development of a bioclimatic law which, it is claimed, will have a broad application not only to entomological research and practice but to general biological research and all periodical practice in agriculture.

INVESTIGATIONS OF INSECTS INJURIOUS TO VEGETABLE AND TRUCK CROPS.

The work on insects injurious to vegetable and truck crops has been conducted, as heretofore, under the direction of Dr. F. H. Chittenden. The most important subjects of research during the year have been insects as carriers of plant diseases; insects injurious to potatoes, sugar beets, beans, and peas; and insects injurious to cucurbits and cruciferous crops.

INSECTS AS CARRIERS OF PLANT DISEASES.—The work on insects as disseminators of plant diseases was begun in May, 1916, particular attention being given to the carriers of cucumber diseases, and was conducted in cooperation with the Bureau of Plant Industry and owners of salting stations at Plymouth, Ind., Madison, Wis., and Big Rapids, Mich., the work being continued throughout the growing season. Demonstration and experimental spraying and trap-crop work were undertaken and community demonstration spraying was conducted over a considerable acreage at each station. Many experimental spray plots were utilized and a large variety of insecticides were tested.

Experimental work to determine the relation of the striped cucumber beetle and the 12-spotted cucumber beetle to bacterial wilt and the mosaic disease of cucumbers and the status of these beetles as factors to be dealt with in the control of these diseases is still in progress. Several important points have been brought out, resulting in the elimination of a number of insecticides as ineffective or injurious to the plant. The most promising have been retained for further tests during the coming season. It was noted that Bordeaux mixture acted strongly as a repellent and consequently was unsuitable for use where poisoning of the beetles was desired. On trap crops 98 per cent of the beetles were destroyed with the crude oil soon after their emergence. Additional work will have to be done to determine the value of the various trap crops. Fall treatment of cucumber fields proved of great value in destroying the beetles before hibernation. Observations of vital importance from both the scien-

tific and practical standpoints, as indicating the probable origin and control of disease infection, have been made with reference to early food plants. A large collection of cucurbits was maintained, upon which observations were made throughout the season, the preference of the beetles for each as a food plant being noted.

In cooperation with plant pathologists of the Bureau of Plant Industry, an attempt was made to overwinter a large number of cucumber beetles by feeding them on diseased and healthy vines, the object being to ascertain whether they would transmit the mosaic disease in the spring when placed on healthy plants. This point remains yet to be established, since the beetles failed to hibernate successfully. The conclusions reached at the Madison, Wis., station were that lead arsenate at the rate of 4 pounds to 50 gallons of water is the most efficient poison. Arsenate of lead sweetened was more than twice as efficient as plain arsenate of lead.

The tarnished plant-bug, melon aphid, common squash bug, and onion thrips, were studied as possible carriers of disease.

The spinach aphid has been under observation in tidewater Virginia for several years, and results are available for publication. Experiments show that this species transmits the spinach blight or mosaic. It is held in check to a large extent by introduced predacious enemies and climatic factors, although during exceptional outbreaks areas must be sprayed to effect control.

SUGAR-BEET INSECTS.—In California the beet leafhopper was the principal subject of investigation, and a preliminary report has been prepared in which this insect as the disseminator of the "curly top" of sugar beets is discussed. Additional wild plants that harbor the virulent factor of this disease have been discovered and shipments of parasites from Hawaii have been made. At the California field station also the bean aphid and salt-marsh caterpillar are being investigated.

Studies of the development, seasonal history, and control of the western flea-beetle in Colorado have been practically completed. This species is implicated in injuries to the sugar beet.

In addition to the work conducted at Pasadena, Cal., agents have been engaged in work on sugar-beet wireworms. The beetles, or adults, were killed by poisoned baits, but additional experiments are necessary to determine the value of these. For killing the larvæ, or wireworms, poisoned baits were unsuccessful.

An important insect enemy to sugar-beet seed production, the false chinch bug, has been the subject of observation throughout the year, and measures for its control on seed beets have been devised in cooperation with the Bureau of Plant Industry. Careful study is being made to determine to what extent the nymphs can be controlled on their natural wild food plant.

Investigations of the sugar-beet webworm have been completed. The insect is readily controlled in its larval form with arsenicals.

BEAN AND PEA INSECTS.—The pea aphid has been under observation during the past year in Virginia, Michigan, and California, and additional food plants have been recorded. Studies of the life history of the bean ladybird have been completed. Additional work remains to be done in securing satisfactory arsenicals for use on very young beans.

The cowpea weevil is most injurious in the South and is a constant source of complaint, in spite of much correspondence on the subject and the distribution of information in the form of circular letters.

INSECTS OF POTATO, TOMATO, AND RELATED PLANTS.—The Colorado potato beetle, according to reports, is being found in new regions, and owing to high and constantly increasing prices of insecticides there may be difficulty in controlling it. Its westward and southward extension of range is being watched constantly.

The potato flea-beetle has been unusually injurious during the spring of 1917, and further work on this pest is being done.

The two common species of tomato hornworms have been the subject of successful control experiments in the vicinity of the District of Columbia.

A severe outbreak of the potato stalk-borer, estimated to have destroyed all the eggplant in some fields in Kansas, was reported during October, 1916, too late for the application of remedies. The spinach aphid and the potato aphid have been the cause of considerable injury to potatoes and tomatoes from the Gulf region to Minnesota; the reports reached this office too late for experiment. All these insects will be investigated as opportunity offers.

Valuable notes on the garden flea-hopper were obtained, and the scarcity of the insect showed that, in spite of the fact that weeds and other debris were left for hibernation, few adults survived the cold winter and spring. It was controlled successfully in greenhouses in the winter.

Other important enemies of potato and related crops have been studied carefully, especially in Kansas and Louisiana.

INSECTS AFFECTING CRUCIFERS.—Results of completed studies of the diamond-back moth have been published in the Journal of Agricultural Research, and a publication on the horse-radish flea-beetle (Department Bulletin No. 535) has been issued. Considerable study has been given to the harlequin cabbage bug from the District of Columbia southward to the Gulf region.

SWEET-POTATO INSECTS.—In Louisiana and Texas the life history and control of the sweet-potato weevil or borer has been the subject of constant investigation and the results, it is believed, will be completed and available for publication in another year. Its further dissemination from the Gulf region by means of seed potatoes can and should be prevented, as the insect is not known to fly in this country. The sweet-potato leaf-roller, a new insect pest, has been studied and the results are available for publication. A sweet-potato sawfly also has been studied.

INSECTS INJURIOUS TO STRAWBERRY, BLACKBERRY, AND RELATED PLANTS.—The investigation of insects injurious to strawberry, blackberry, raspberry, and related plants of the rose family is being conducted in Louisiana, Florida, Michigan, and Oregon. The strawberry root-weevil, the rose weevil, the crown borers, and two species of caterpillars are among the principal insects that are being investigated. A falseworm on strawberry is being studied, and strawberry aphids have received practical attention.

MISCELLANEOUS.—In Louisiana, at the Baton Rouge station, considerable work has been done on a root-aphis on cultivated crucifers. The bean leaf-beetle has been the subject of tests with insecticides from Louisiana to Maryland and Virginia. Poisoned baits have been partially effective for slugs or shell-less snails. Cutworms were controlled completely by the ordinary poisoned-bran mash.

The zebra caterpillar occurred in such numbers that it fed upon weeds in addition to beets and other vegetables, but it succumbed completely to control by its parasites. Experiments were made with contact insecticides in different proportions on various forms of plant-lice.

The celery leaf-tyer was the subject of experiments at Smeltzer, Cal. Good results were obtained in the plots sprayed at intervals of 10 days throughout the season. Plots sprayed only early or late were badly damaged.

Facilities have been secured for experimental fumigation of greenhouse pests on truck crops and experiments have been performed with a number of fumigants.

Features of the work conducted in the District of Columbia have been the rearing of the natural enemies of insect pests and the making of maps showing the distribution of the more important truck-crop insects. Eighty of these maps have been prepared.

Because of war conditions, farmers, truck growers, and other persons having land for cultivation have endeavored to produce larger yields of the principal crops, such as potatoes, beans, and peas, and as a result a number of serial publications have been projected to supply the need for information in regard to the control of the insects most seriously affecting these crops. In addition to the publications previously mentioned are the following Farmers' Bulletins: No. 762, The False Chinch Bug and Measures for Controlling It; No. 766, The Common Cabbage Worm; No. 856, Control of Diseases and Insect Enemies of the Home Vegetable Garden (prepared in collaboration with the Bureau of Plant Industry); No. 868, How to increase the Potato Crop by Spraying (prepared in collaboration with the Bureau of Plant Industry); No. 837, The Asparagus Beetles and Their Control. Circular letters have been prepared covering the use of arsenate of lead as a spray for truck crops; the use of nicotine sulphate for garden insects; the control of bean and pea weevils; the control of the tarnished plant-bug; the preparation and use of kerosene emulsion; remedies for sowbugs; and the control of the stalk-borer.

STORED-PRODUCT INSECT INVESTIGATIONS.

Investigations of stored-product insects, as in former years, have been under the direction of Dr. F. H. Chittenden. Some of the projects mentioned in recent reports have been followed out and new work has been done. One of these was a series of experiments conducted in Louisiana to determine the value of metal cribs for the proper ventilation and fumigation of stored corn.

In Florida a special investigation has been made of the effect of X rays on various forms of insects subsisting on stored products. In so far as possible all stages of each insect have been tested. Work has been done to find out the most effective (1) voltage, (2) milli-

amperage in the tubes, (3) distance of treated material from the focal support of the tube, and (4) length of treatment necessary to destroy insect life. The experiments will be closed when the cost per volume of treated material has been determined for the various species of stored-product insects examined. This will enable manufacturers to calculate easily the expense of X-ray sterilization and to determine whether it is practical for their purposes. The value of this form of treatment of stored-product insects lies in the fact that it is possible to sterilize sealed cartons and thus guard against infestation.

A general investigation of the different ways of storing grain was made by agents in the field that the possibilities or probabilities of infestation, the degree of cleanliness, and the practicability of fumigation in each case might be determined.

A new enemy of rice and other stored products has been investigated and the work is nearly completed. The rice weevil was found in piles of straw thrashed in each of the years 1913, 1914, and 1915, and in shocked corn in the field. Much advice has been given in regard to the weevils injuriously affecting beans, peas, cowpeas, and other edible legumes. Nearly a dozen species of these weevils are under consideration, and new facts have been learned in regard to their life history and the effect of cold as a remedy. Observations were made on the successful heating of a flour mill at Dodge City, Kans., to destroy the Mediterranean flour moth.

For several years no one has been able to explain why the Angoumois grain moth has been very injurious in portions of Pennsylvania and not so injurious in adjoining States. Investigations by this bureau in April, 1917, showed that the wheat growers in the vicinity of York and other sections of Pennsylvania have a custom of cutting the crop with a self-binder from the latter part of June to the first of July, after which it remains in shock three or four days and is then carried directly into the barn for "curing," provided the weather permits. Grain and straw are stored in bundles in the large, well-built barn mows in Pennsylvania and thrashed out at any time convenient to the grower. On April 30 it was ascertained that many farmers had not thrashed their grain, and others had just finished. The barns in which the grain is stored are ordinarily of stone, extremely well constructed, and, being warm, are especially conducive to injury by the Angoumois grain moth, as in the dark portions of such barns this insect can develop throughout the winter. In Maryland and Virginia the grain crops are thrashed as soon after harvesting as possible, and the grain is stored in cool repositories. The farmers of Pennsylvania have been advised to thrash their grain by the middle of August and to store it in tight Osnaburg sacks as a preventive of injury. The barns, of course, must be fumigated thoroughly with carbon disulphid or hydrocyanic-acid gas and be cleaned well before storage. A loss of from 16 to 25 per cent of the wheat is common in the State, and one cleaner is known to have cleaned as much as 25 pounds of infested grain from one bushel of wheat sent to his mill. With a total change of practice, including early thrashing, cold storage, the employment of fumigants, and careful cleaning up of infested barns, the State soon should be rid of this pest.

INSECTS AFFECTING TROPICAL AND SUBTROPICAL FRUITS.

Mr. C. L. Marlatt continued in immediate charge of the bureau's investigations of tropical and subtropical fruit insects.

CITRUS-FRUIT INSECTS IN CALIFORNIA.—Control of the common mealybug on citrus trees has formed the major project of this investigation during the season of 1916-17. It has been discovered that ants, especially the Argentine ant, cause an increase in the severity of infestation and hinder the control of this pest. Numerous experiments in orchards infested by the Argentine ant have demonstrated that the common mealybug will be held in control through the agency of beneficial insects where trees are kept clean of ants. Fumigation with hydrocyanic-acid gas as practiced against scale insects prevalent on citrus trees has been found to be ineffective against mealybugs. Spraying with water under pressure has been carried on successfully. A promising new contact insecticide has been developed. A Farmers' Bulletin (No. 862) dealing with this insect is in press.

The work on the fumigation of citrus trees with hydrocyanic-acid gas, which has been a part of this project in former years, has been practically completed and the preparation of a Farmers' Bulletin to serve as a manual for the conduct of fumigation work, either by individuals or by fumigation companies, has been nearly completed.

CITRUS-FRUIT INSECTS IN FLORIDA.—The orchard demonstrations of control of the citrus white fly and rust mites have been continued and enlarged, and information as to methods of control has been distributed by means of departmental publications and articles in the local agricultural press. The methods that have been developed by the bureau are coming into general adoption, and the work has met with hearty appreciation on the part of State citrus growers.

The work upon citrus insects in Florida has reached a stage when it can be classed very largely as educational and demonstrational, and it is planned to continue this work in future in cooperation with the State extension service.

A number of minor insect enemies of citrus have been the subject of investigation during the year, and a number of new insecticides for citrus pests have been tested.

THE ARGENTINE ANT IN RELATION TO CITRUS INSECTS.—The investigation of the Argentine ant in its relation to citrus insects has been completed as a special project, and the information obtained will soon be available in a bulletin covering the work as a whole, and in a Farmer's Bulletin summarizing the practical results.

INSECTS AFFECTING TROPICAL AND SUBTROPICAL FRUITS AND PLANTS IN GREENHOUSES.—Results of investigations on the use of hydrocyanic-acid gas as a means of controlling insects in greenhouses have been published as Bulletin 513 of the department. The insecticides commonly employed in the control of insects infesting greenhouse plants have been investigated, and a manuscript on this subject has been offered for publication. Outbreaks of the chrysanthemum and rose midges and the phlox bug have received attention, and practical methods of control have been worked out. Attention has been given also to the control of termites in greenhouses.

MEDITERRANEAN FRUIT FLY AND MELON FLY.—The control, under the Mediterranean fruit-fly and melon-fly quarantine, of fruits and vegetables shipped from the Hawaiian Islands to the mainland of the United States is a continuing operation conducted in cooperation with the Federal Horticultural Board. New regulations have been issued during the year simplifying the control of the movement of Hawaiian fruits and vegetables and giving somewhat greater latitude of movement.

The biological and research side of this work has been limited largely to a study of introduced parasites to determine the conditions under which they can be best distributed and maintained. Some of the results of this biological study are very interesting and have an important bearing on the general problem of control of insects by parasites, and are particularly useful as indicating the desirability of strict control of the importation of parasites that individually may be classed as useful but that when combined may be detrimental to one another. In the case of the fruit fly it was found that two parasites, each one of which was very useful by itself, were in a measure mutually antagonistic, and the combined work of both was proving less effective than the individual work of the otherwise more efficient one of the two.

BEE-CULTURE INVESTIGATIONS.

Under the direction of Dr. E. F. Phillips, the work in bee culture during the past fiscal year has been a continuation of the lines of investigation previously instituted, with the important addition of extension work on this subject. As in previous years, the investigational work has been conducted at the branch laboratory and apiary at Drummond, Md.

DEMONSTRATIONS IN BEE CULTURE.—The appropriation for the past fiscal year for this office authorized for the first time extension work in beekeeping, and this work was begun. One specialist was appointed to cooperate with the Office of Extension Work South, States Relations Service, and he has visited during the year a number of Southern States to attend meetings of county agents and special meetings of beekeepers arranged by the various State extension directors. Without exception the interest manifested at these meetings exceeded the original expectations, and the calls for this specialist greatly exceed the time at his disposal.

A specialist in beekeeping was assigned to North Carolina to work in cooperation with the State Extension Division. As a result of his labors an association of the beekeepers of the State has been formed. He has cooperated with the county agents in holding meetings and demonstrations in the apiaries, and the outlook for a great increase in the importance of beekeeping in the State is good. The work was discontinued temporarily on account of the resignation of the specialist, but another specialist has been appointed and the work is progressing satisfactorily. During the year a report on North Carolina beekeeping (Department Bulletin No. 489) was published, giving the results of preliminary work in 1915.

Another specialist to work in cooperation with the State Extension Division was assigned to Tennessee. In general his work has been

similar to that carried on in North Carolina, but special attention has been given to the organization of county societies of beekeepers. During the year a railroad in the State ran a special bee, poultry, and marketing train for three weeks. The State beekeepers' association has been strengthened by this activity, and the prospect of making beekeeping an important branch of agriculture in Tennessee is bright.

The regular extension work in beekeeping thus far has been confined to the Southern States. In this section 45 per cent of the bees in the United States are located, but probably 80 per cent are in log "gums" or box hives and relatively few of the commercial beekeepers operate on an extensive scale. These States produce less than 20 per cent of the honey crop. It was thought best to carry on the work only in this region so long as the amount available for the work was small. Men have been sent from the office into certain Northern and Western States during the year for somewhat similar work. A few of the Northern States are doing a little extension work in beekeeping by utilizing the men who teach beekeeping in the agricultural colleges. Another series of beekeepers' conventions was attended during the year.

WAR EMERGENCY WORK.—The shortage in the food supply, and especially the shortage of sugar, makes it highly desirable that honey production be increased as rapidly as possible. When war was declared all research activities of the office were suspended temporarily and a vigorous campaign was instituted to stimulate beekeepers to increase honey production. In cooperation with the States Relations Service circulars were sent to every county agent in the country for distribution. Two circulars were sent at different times to each honey-crop reporter of the Bureau of Crop Estimates. Circular letters were mailed to individual beekeepers in 16 of the chief producing States, to various associations, and to lists of dealers in supplies. A large number of circulars have been used in connection with general correspondence. The first campaign was closed on June 1, because after that date a beekeeper usually can not change his plans for the year materially. The total number of circulars issued between the time war was declared and June 1 was 152,280, of which several were of two or three pages. During June no new circulars were issued but the envelopes were addressed for a number of additional States in anticipation of a circularizing campaign in July.

The response of beekeepers to the circulars has been striking. This is shown by the letters received since the work began. The replies have been most enthusiastic, and this is roughly indicated by the fact that the incoming mail during May and June was fully fifteen times as heavy as at any similar period.

In addition to the direct stimulation, several press notices were issued. The bee journals have cooperated enthusiastically in this campaign, and it is believed that there are few beekeepers in the United States who have not been made aware of the need for more honey.

An interesting feature of the campaign was a conference held at the Drummond, Md., laboratory on April 23. Invitations were sent to editors of bee journals, manufacturers of beekeepers' supplies, teachers of beekeeping, and inspectors east of the Mississippi River. The purpose of the conference was to coordinate the work of those

especially concerned in the conduct of the campaign for more honey, and the meeting was highly successful.

Mention should be made of the honey-market news service begun on June 15 by the Office of Markets and Rural Organization at the request of this bureau. This was proposed before war was declared, but is especially timely now. The market news service should serve to curtail speculation and make the market more stable.

WINTERING OF BEES.—Work on the wintering of bees has been continued chiefly in testing various methods of packing for colonies wintered outdoors. The various commercial insulated hives used in the United States were again tested in comparison with hives heavily insulated in special packing cases. Even in the mild climate of Washington there was a marked advantage in the heavy packing, and by the middle of June the colonies that had been well packed were still markedly stronger than those that were poorly packed. This is a point of importance, as many beekeepers have believed that before the clover honey flow weak colonies will build up sufficiently to gather a full crop. The records are not complete, but it is evident that the colonies heavily packed will produce this year an average crop of over 50 pounds and possibly 100 pounds more than those insufficiently packed. A colony packed in the fall of 1915 with 16 inches of sawdust on all sides, top, and bottom, was allowed to remain packed during the entire summer of 1916 and until the spring of 1917. It did not suffer from excessive heat during the summer and again wintered perfectly and is now one of the strongest colonies in the apiary. Evidently beekeepers have nothing to fear from excessive insulation at any season of the year. Tests were made with colonies wintered in two hive bodies, the top one being well filled with honey and the entire hive being heavily packed. These colonies wintered much better than those equally well packed in single hive bodies. The work with bees in a special respiration calorimeter mentioned in the last annual report was taken up again in the fall of 1916, but an accident to the apparatus caused it to be discontinued. Such work can be done only in a brief period in the fall, when the bees are without brood and before there is an accumulation of feces in the intestines. It is necessary, therefore, to wait until the fall of 1917 to renew this investigation.

DEVELOPMENT OF THE BEE.—Studies on the development of the bee have been carried on for some time. At present the work on the anatomy of the larva is being completed and certain interesting phases of larval behavior are being studied. The war emergency has interfered greatly with this project.

DISEASES OF BEES.—On September 1, 1916, the specialist who has been engaged in a study of the etiology of bee diseases completed this work and his results are being prepared for publication. An extensive report on sacbrood (Department Bulletin No. 431) was published during the year. A paper on the spore-bearing bacteria of the apiary has been published in the *Journal of Agricultural Research*. This will prove valuable to laboratory workers on brood diseases. Another paper for the laboratory diagnostician was prepared, giving the methods of diagnosis of samples submitted for examination. Future work on bee diseases will deal chiefly with the more practical

phases of treatment, especially for European foulbrood. Attention also is being given to diseases of adult bees.

SPRAYING FRUIT TREES: EFFECT ON BEES.—Investigation of the effect that the spraying of fruit trees has on bees has been conducted since 1914 in cooperation with the Deciduous Fruit Insect Investigations of the bureau. During the year 1917 this work has been done at the Bee-Culture Laboratory at Drummond, Md., it having been impossible to release a man for work elsewhere on account of the war emergency. In connection with this work some interesting data have been obtained regarding the length of life of adult bees in relation to the honey flow. These will be prepared for publication.

REPORT OF CHIEF OF BUREAU OF BIOLOGICAL SURVEY.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF BIOLOGICAL SURVEY,
Washington, D. C., August 20, 1917.

SIR: I have the honor to submit herewith a report on the work of the Bureau of Biological Survey for the fiscal year ended June 30, 1917.

Respectfully,

E. W. NELSON,
Chief, Biological Survey.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

WORK OF THE BUREAU OF BIOLOGICAL SURVEY.

The work of the Bureau of Biological Survey is conducted along five principal lines: (1) Investigations of the food habits of North American birds and mammals in relation to agriculture, in charge of Dr. A. K. Fisher; (2) biological investigations with special reference to the geographic distribution of native animals and plants, in charge of E. W. Nelson; (3) supervision of national mammal and bird reservations, in charge of G. W. Field; (4) enforcement of the Lacey Act regulating the importation of birds and interstate shipment of game, in charge of W. F. Bancroft; (5) administration of the Federal migratory-bird law, in charge of George A. Lawyer.

ECONOMIC INVESTIGATIONS.

PREDATORY ANIMALS AND RABIES.

The larger part of the work of this section of the Bureau has a direct practical bearing on the increased production and conservation of the Nation's food supply. It is effective in decreasing the great losses of live stock which occur through the ravages of predatory animals and in the reduction of still greater losses of grain and other crops due to noxious rodents. About \$287,000 was available during the year for the destruction of wolves, coyotes, bobcats, mountain lions, and other stock-killing predatory animals on the public domain, and for the suppression of rabies widely prevalent in several of the western and northwestern States. This work, already in progress, was expanded and perfected under the original organization, by districts, as follows: (1) Arizona and New Mexico; (2) California and Nevada; (3) Oregon and Washington; (4) Colorado; (5) Idaho; (6) Montana; (7) Utah; (8) Wyoming; (9) Texas.

Each district is in charge of an inspector aided in some cases by an assistant inspector.

The force of hunters and trappers employed has varied according to the season, from 175 to 300 men, who receive salaries for their services and are not permitted to accept bounties from any source. All the skins of animals taken became the property of the Government and were sent to Washington for disposal. Many of these were added to the zoological collection of the United States National Museum and the remainder were sold as other Government property, the net proceeds, amounting to approximately \$36,000, being turned into the Treasury.

Trapping, poisoning, and shooting, supplemented by den-hunting during the breeding season, have proved to be the most effective means of reducing the numbers of these animals. Marked improvements in the preparation and distribution of poisoned baits, as well as in scent-baiting traps, have been made during the year. All improvements in methods are at once made known to the entire force of official trappers and widely demonstrated among interested stockmen.

During the year 30,512 predatory animals were taken, including 556 wolves, 22,342 coyotes, 107 mountain lions, 3,053 bobcats, and 60 bears. Bears are generally considered game animals and are not molested by the predatory-animal hunters except in cases of individuals known to have the habit of killing stock. In addition to the capture of animals by means of traps and shooting, extensive poisoning campaigns were conducted, and it is conservatively estimated that at least 75,000 predatory animals were destroyed in this manner.

As a result of this destruction of stock-killing animals a large saving of cattle, sheep, goats, horses, swine, and poultry has been effected, in addition to reducing greatly the danger to human life from rabies. Stockmen have shown much interest in the work and in numerous instances have contributed funds for cooperation. The States of Nevada, Utah, and Washington are also cooperating, having appropriated substantial sums for the purpose.

Few people except those directly affected realize the extent of the losses of stock by predatory wild animals and the necessity for their control. In Colorado a single wolf took a toll of nearly \$3,000 worth of cattle in one year; in Texas 2 wolves killed 72 sheep valued at \$9 each during a period of two weeks; 1 wolf in New Mexico killed 25 head of cattle in two months; in Oregon 4 coyotes in two nights killed 15 pure-bred rams valued at \$20 each; one bobcat in Texas killed over \$300 worth of Angora goats, and another, taken at Ozona, N. Mex., in a month had killed 53 lambs, 1 ewe, and 1 goat belonging to a single ranchman.

The damage done by predatory animals has been vastly increased by the prevalence among them of rabies. This disease spread from the point of origin in Oregon into the States of Nevada, California, Idaho, and Utah. Cattle and sheep were destroyed in large numbers and hundreds of persons were bitten. As a result of the campaign conducted by this bureau in cooperation with local authorities and stockmen, the spread of the disease has been checked and conditions have been greatly improved. It is believed that with a continuance of the work complete eradication of this alarming disease among the wild animals of the affected States can be accomplished.

GROUND SQUIRRELS.

The work of exterminating ground squirrels on Government lands within the Fort Totten Indian Reservation, North Dakota, and the Sequoia and California National Forests of California, has been continued, and 208,553 acres have been practically cleared of these destructive pests. The result has been increased productiveness of the lands treated, and also the protection of the crops on adjacent areas. The total cost of this work, including labor, has been approximately 5 cents per acre in North Dakota, and 6 to 7 cents in California.

The methods employed by the bureau have been demonstrated among farmers, who have cooperated in poisoning ground squirrels on holdings adjacent to the public lands treated. In North Dakota organized campaigns against ground squirrels in cooperation with the State Extension Service have continued with increased vigor and thoroughness. The squirrels on about 7,500,000 acres were poisoned during the year by 19,000 cooperating farmers. This resulted in the practical extermination of the pest on the areas treated and a saving in this year's crops valued at more than \$1,000,000. Similar savings may readily be effected elsewhere in the vast areas infested by these animals.

Campaigns along the same lines, under project agreements, have been started in Montana, Idaho, and Oregon in cooperation with State extension services and are being planned for other States. Demonstrations of methods have been made on a large scale in Nevada and California, where increasing interest is being developed in organizing systematic campaigns for the extermination of ground squirrels.

RABBITS.

Serious depredations by jack rabbits upon wheat, barley, oats, alfalfa, and other growing crops and stacked hay necessitated continued efforts for their control in eastern Oregon, California, Idaho, Nevada, Utah, Colorado, New Mexico, and Texas. Effective methods of poisoning the animals were demonstrated and successful campaigns in farming communities organized against them. This work was very successful and enormous numbers of animals were killed. In a single county in Oregon about 75,000 were poisoned at a cost of less than one-tenth of a cent each.

Cottontail rabbits have damaged orchards, grain, and truck farms, especially in Virginia, West Virginia, Maryland, Delaware, and New Jersey, and advice and demonstrations have been given for protection against them.

The European hare, introduced into New York some years ago, has increased and is spreading rapidly in southern New York and adjacent States, where it has done extensive damage to orchards. Investigations have been started to discover methods for the control of this animal, which threatens to become a dangerous pest.

PRAIRIE-DOGS.

Campaigns against prairie-dogs upon national forests and other public lands have been prosecuted vigorously in Arizona, New Mexico, Wyoming, Colorado, and Montana. The first poisoning of

the animals has been completed on about 1,000,000 acres at an average cost of from 5 to 10 cents an acre, resulting in the destruction of about 90 per cent of the animals. In addition 289,000 acres on which the first poisoning had already been done were given a second treatment, resulting in the practical extermination of the pests. As many as 300 dead prairie-dogs have been counted in an alfalfa field within 24 hours as a result of distributing grain poisoned with only one ounce of strychnin. The importance of this work is made evident by an estimate of the Forest Service that the range for live stock improves 50 per cent after the prairie-dogs have been destroyed.

The success of this work on public lands has induced extensive cooperation by private owners. Farmers and stockmen have been aided by demonstrations and have been assisted in organizing, directing, and supervising comprehensive campaigns. As a result a large saving has been effected in growing crops and good yields have been secured on large areas where in many cases the prairie-dog infestation had previously rendered the production of crops an almost hopeless undertaking. Arrangements have been made to increase this work through cooperation with the extension services of several States.

POCKET GOPHERS.

The elimination of pocket gophers from the Ochoco National Forest of Oregon was continued during the fall, and 95 per cent of the animals were destroyed from about 13,000 acres which had been heavily infested. Extensive demonstrations of methods of poisoning were held among the farmers in California, Washington, Oregon, and Idaho, resulting in the elimination of these destructive pests over considerable areas of orchard and other farm lands.

NATIVE MICE AND RATS.

Pine mice, meadow mice, and deer mice have wrought serious havoc in orchards, gardens, and truck and potato farms, as well as in melon-producing districts throughout extensive areas, especially in the Eastern States. Investigations have been conducted and demonstrations of effective methods for the eradication of these pests have been given in Virginia, West Virginia, Pennsylvania, Maryland, Ohio, Indiana, and Iowa, and advice for protection against them has been given on request in many other States. In one county in Virginia the horticultural commissioner estimated a loss of \$100,000 to orchardists from apple trees killed by pine mice during the year.

Investigation of damage to forest nursery stock by wood rats has been conducted on the planting areas of the Converse Experiment Station of the Forest Service in California. Many facts of importance relating to their habits and depredations have been determined and advances made in the methods for their control.

HOUSE RATS AND MICE.

The initial steps have been taken to launch a nation-wide campaign for the more adequate control of house rats and mice, notorious destroyers of field crops, stored products, and poultry. Many data relative to damage by them have been assembled, and present conditions in many localities were ascertained by direct inspection. Efforts

have been made to acquaint people with the seriousness of the losses and with simple and effective means of preventing them.

MOLES.

Through investigation of the Townsend mole, a serious farm pest in western Washington, Oregon, and northern California, effective methods for trapping it have been devised, and the fact that its fur possesses a good market value has been demonstrated. Through the efforts of this bureau a market has been found for the fur, and demonstrations throughout the infested area have resulted in extended campaigns for the destruction of these animals and the utilization of their skins. The value of the fur probably will pay for the cost of eliminating the pest.

MOUNTAIN-BEAVERS.

The mountain-beaver, or sewellel, an animal hitherto confined to the forests of Washington and Oregon, and of little economic importance, has recently spread into cultivated fields and caused extensive damage to small fruits and market produce. In response to requests for assistance investigations have been conducted and results obtained which indicate that this rodent may be successfully controlled.

FUR-BEARING ANIMALS.

Studies of the adaptability of native fur bearers to domestication have been continued at the Experimental Fur Farm, in Essex County, New York. The animals now confined there comprise blue foxes, minks, martens, fishers, and skunks. Experiments are being made concerning the feeding, housing, and general management of these animals. Inclosures for the blue foxes, martens, minks, and skunks have been constructed and a fisher yard is now building. Other equipment completed during the year includes an ice-pond, ice-house, and refrigerator, a meat drier, and a workshop.

In addition to the information gathered at the Experimental Fur Farm, an effort has been made to keep in close touch with all phases of the fur industry, from the care of animals to methods of dressing, dyeing, cleaning, and storing furs, in order to make this information available to many inquirers.

The edition of the department bulletin on "Silver Fox Farming" published last year was quickly exhausted and a new Farmers' Bulletin based upon it has been issued. Two other papers—a yearbook article entitled "Fur Farming as a Side Line" and a Farmers' Bulletin containing a summary of laws governing the capture, protection, and propagation of fur animals in the United States and Canada—were published during the year.

FOOD FOR WILD DUCKS.

The extended investigations by the bureau of the food habits of wild ducks are beginning to bear fruit in the form of reports for publication. During the fiscal year there were completed accounts of the feeding habits of three groups—the mallard, the teal, and the gadwall and baldpate. The studies necessary to the production of

these reports have been the basis also of publications on the propagation of wild-duck foods, four of which have been issued, one during the present year. This latest bulletin treats in detail eight groups of wild-duck food plants and recommends 40 others in the hope that dealers may be induced to put them upon the market. Sportsmen are showing a lively interest in this part of our work, owing to its direct practical bearing on the perpetuation of our migratory waterfowl.

STARLING STUDIES.

Field investigation of the economic status of the introduced starling, begun in April, 1916, was continued until the middle of October in New Jersey, Pennsylvania, New York, Connecticut, Rhode Island, and Massachusetts. Subsequently, most of the stomachs collected were examined in the laboratory and the resulting information placed in tabular form.

The starling has been found destructive to cherries and, to a much less degree, to late fruits, but the bird has been proved also to have many redeeming qualities. While the exact extent of its insect-eating habits can not be established until all the material is examined, enough has been learned to warrant the statement that it is one of the most effective bird enemies of ground-insect pests, in this respect ranking much higher than some of our common native birds.

Reports that starlings are driving out native species are frequently exaggerated, and, when considered from a purely economic standpoint, should cause no alarm, as the starling must be considered at least equal, if not superior, to two of the species most frequently molested, namely, the flicker and the robin. The latter, especially, is proving to be a distinct menace to the raiser of small fruits in some sections of the Northeast. Experiments were conducted to perfect methods for eradicating starling roosts where these are established in residential sections of cities.

ECONOMIC STATUS OF OTHER BIRDS.

Examination of bird stomachs by groups was continued to the extent permitted by other assignments of the staff. The principal work along this line was analysis of pellets of owls, and of the stomach contents of hawks and owls. Studies of the wood duck were completed, and a large number of stomachs of cowbirds, red-winged and crow blackbirds, and robins collected during the starling investigation were examined, to supply data for comparison between the economic tendencies of these birds and the starling. A Farmers' Bulletin entitled "Common Birds of Southeastern United States in Relation to Agriculture" was published during the year. It shows the food habits of 23 species of that region and gives a general account of the relations of birds to the insect pests of the South. A report on "The Crow and Its Relation to Man" and on "Food Habits of the Swallows: A Family of Valuable Native Birds" have been submitted for publication.

INFORMATION ON ATTRACTING BIRDS.

By means of a series of publications information has been disseminated on methods of attracting birds and increasing their numbers. Most of the species which are susceptible of approach along

these lines are chiefly beneficial to man, and increasing their numbers is equivalent to decreasing losses by injurious insects. The problem of attracting such birds has been treated by sections of the United States, and publications on the Northeastern and Northwestern States have been issued. One relating to the Middle Atlantic States is in press and one for the East Central States has been prepared for publication. A further manuscript in this series, entitled "Attracting Birds to Public and Semipublic Reservations" also has been completed.

THE CARE OF CAGE BIRDS.

In response to a large and growing correspondence relating to canary birds, a Farmers' Bulletin entitled "Canaries: Their Care and Management" has been issued. In it the history of the domestication of this bird is touched upon, and a brief account is given, with illustrations, of the common and fancy varieties, which are distinguished by shape and color. The chief usefulness of the bulletin is in its discussion of practical problems on the care and breeding of these popular cage birds.

DISEASES OF WILD DUCKS IN UTAH.

The investigations of the conditions that cause the death of enormous numbers of wild ducks and other waterfowl around Great Salt Lake, Utah, were completed at the close of the field season of 1916. An assistant engaged in this work was stationed in the marshes in the Bear River delta, at the northern end of Great Salt Lake, from May until October. Experimental work and field observations were carried on there at a temporary field laboratory, and the cause of the main trouble was definitely established as due to chlorides present in the alkaline waters and in the efflorescences on the mud flats. A report, embodying the results of this work has been prepared for publication.

It was learned in 1915 that a considerable number of waterfowl of various species die in different parts of the country every year from lead poisoning caused by eating the scattered shot that accumulate at the bottom of the water about shooting blinds. Further investigations into this trouble were made during 1916, and a report thereon completed.

During the course of these investigations much information was gathered concerning the breeding, summer and fall movements, and habits of wild ducks in the great marsh areas at the mouth of Bear River, Utah. A study was made of the available natural food supply for waterfowl, and in 1916 a count was made of the breeding ducks of that region. A report covering these observations is in course of preparation.

BIOLOGICAL INVESTIGATIONS.

Field investigations of the distribution, abundance, and habits of birds and mammals have been carried on in various parts of the United States, and the work of collating published information on the same subjects has been continued. The information gathered has been of use in the other activities of the bureau, concerned with the administration of the Federal migratory-bird law, the enforcement

of the Lacey Act, the regulation of importations and interstate shipments of birds, the maintenance of bird and mammal reservations, and investigations of the economic relations of birds and mammals.

DISTRIBUTION AND MIGRATION OF BIRDS.

Reports on the migration of birds were received, as in past years, from more than 300 volunteer observers located throughout the United States, in many parts of Canada, and in Alaska. Information regarding the distribution and migration of birds was gathered from many published sources as well. The data secured from these various sources were tabulated on about 100,000 cards, which were added to a file system already containing more than 1,000,000 cards. Progress was made in the preparation of reports on the distribution and migration of several families of waterfowl.

BIRD COUNTS.

The second annual report of bird counts in the United States, with discussion of results, was published. Results of the third count, made in the summer of 1916 by about 200 volunteer observers, have been partly tabulated. The fourth annual count was made by about the same number of observers during the summer of 1917, and many reports have been received. These bird counts throw much light on the conditions most favorable for useful species, and show that the numbers of such species on the farms of the United States may be largely increased by furnishing them protection and food. Results of great interest and value already have been obtained from these counts, and others doubtless will be brought to light as the investigations are continued. After a few years we shall have from these counts the first fairly accurate basis for an estimate as to the increase or decrease of useful birds in certain parts of the country.

BIOLOGICAL SURVEYS.

Progress was made in the biological surveys of Arizona, California, and Montana, and field work on the survey of Oregon was finished. A report on the life zones of Wyoming is now in press, and one on the mammals of that State has been completed. Reports on the birds of New Mexico, mammals of New Mexico, and birds of Texas are ready for publication. Field work on the survey of Alabama was completed and the report on the birds brought up to date. Arrangements have been made with the State of Alabama for cooperation in the publication of this report. A report has been prepared on the mammals of the Canal Zone, forming a part of the results of a biological survey of that region undertaken in cooperation with the Smithsonian Institution in 1911 and 1912. A reconnaissance of the Okefenokee Swamp region of southeastern Georgia was undertaken in the winter, preliminary to a biological survey of the State. Preliminary work also was begun on biological surveys of Washington and Wisconsin.

MIGRATORY WILD FOWL.

During July, 1916, in continuation of work begun in June, an investigation of the principal areas within which migratory waterfowl breed was carried on in various parts of the eastern half of North

Dakota. In the winter field investigations were made on the numbers, distribution, and habits of waterfowl wintering in southeastern Georgia and central and eastern Florida.

TECHNICAL STUDIES.

Technical revisions of the flying squirrels and rice rats were completed and are ready for publication. A revision of the so-called mountain-beavers (genus *Aplodontia*) was finished and arrangements made with the University of California for its publication. Studies of the grizzly and big brown bears were revised and the results are now in press.

As in previous years, a large number of specimens of mammals and birds have been identified for public institutions and individuals, and considerable progress has been made in mapping the distributions of both mammals and birds.

MAMMAL AND BIRD RESERVATIONS.

The section of mammal and bird reservations is charged with the maintenance of 74 national reservations, of which 5, including the Niobrara, originally created as a bird reservation, are big game preserves and 69 are bird reservations; and with the supervision of transfers of game. In the big-game reservations at the end of the fiscal year there were 246 head of buffalo, 184 of elk, and 49 of antelope.

GAME PRESERVES.

NATIONAL BISON RANGE, MONTANA.—The bison herd on the range came through the winter in very satisfactory condition. Thirty calves born in the spring increased the number of buffalo on the range to 194. The losses during the year included 3 adult animals, a bull and a cow that died in the fall of 1916 and a cow that was unable to give birth to her calf. The nucleus of this herd, 37 animals, was placed on the range in the fall of 1909, and 3 others the following year. Only 5 bison have died since the herd was established.

The 75 elk and 26 antelope on the range wintered well, but complete returns on the number of young born to these herds have not yet been received.

A mile of the boundary fence running through the Jocko River Swamp, which was subject to overflow, was rebuilt on higher ground, eliminating a serious danger of animals escaping from the reservation.

WIND CAVE NATIONAL GAME PRESERVE, SOUTH DAKOTA.—With 7 calves born this year the total number of buffalo on this preserve is 34. Animals lost during the year include 1 crippled buffalo, which it became necessary to kill, 2 elk, and 3 antelope. There are 61 elk and 23 antelope on this refuge, exclusive of the young born this year. Antelope born on the range are wilder and apparently hardier than those transferred to the refuge, and it is believed that in time a satisfactory herd of these beautiful and rapidly disappearing animals will be built up.

WINTER ELK REFUGE, WYOMING.—Owing to an unusually severe winter the losses of elk were somewhat larger than usual. During

the spring alarming reports as to the excessive losses of elk in both the northern (Yellowstone) and the southern (Jackson Hole) herds gained circulation, but careful investigation on the ground by employees of the National Park Service, Forest Service, and Biological Survey proved these statements to be unwarranted.

From the investigations and counts conducted by our representatives, together with other reliable information at hand, it is probable that not more than 1,500 elk died because of snow and lack of food in the 240 square miles which constitute the principal winter elk range in the Jackson Hole region. Of this number, approximately 70 per cent were calves, 25 per cent cows, and 5 per cent bulls. Including the snowbound animals illegally killed by tusk hunters and poachers, 2,000 elk are regarded as a close approximation of the total mortality in the region. The great number of deaths along the roads, at feeding places, and at river crossings gave the impressions earlier in the season which were responsible for overestimating the losses.

The total number of elk fed at the Jackson Hole refuge was approximately 6,000. Feeding began on January 15, and the hay was practically exhausted by April 5. Of the 900 elk which died on the feeding grounds this winter, 794 were calves. About 250 calves came from the foothills to the feeding grounds in the latter part of February and nearly all perished. Experience has proved that it is almost impossible to save young elk by feeding hay after they have reached a seriously emaciated condition, and chances for succoring them are greatly lessened where fed with a great band in which older and stronger animals predominate. Experiments will be conducted in fencing off feeding lots where the smaller animals may be fed without interference from the larger and stronger elk, in order to lessen losses in the calf crop.

During the year, 588 rods of fencing have been constructed, protecting about 800 acres of grazing land for the elk. Additional equipment has been purchased, including a team of horses, haying machinery, and other agricultural implements required to insure a larger yield of hay from the reservation through the extension of the irrigation system and the plowing and seeding of certain areas to tame grasses.

In addition to 660 tons of hay harvested on the refuge and fed to the animals, about 400 tons were purchased and fed by the Wyoming State officials.

NIORARA RESERVATION, NEBRASKA.—The small herd of buffalo on this reservation is increasing steadily, as evidenced by 4 calves born this year, making a total of 18 animals in the herd. The 34 elk wintered without losses, but no report on the calf crop has been received. Lack of range facilities in the present small inclosure precludes bringing additional animals to the reservation.

SULLYS HILL GAME PRESERVE, NORTH DAKOTA.—With the completion of the six miles of 88-inch woven-wire fence on Sullys Hill, this game preserve was made ready for stocking early in the year. Contracts have been let for the construction of a 5-room frame cottage as headquarters, together with a frame barn, and these improvements were nearly completed at the close of the fiscal year.

Fifteen elk transferred from Yellowstone National Park (Gardiner, Mont.) in March arrived in good condition, with the exception of 1 animal, which died a few days afterward. Four deer, 3 of which were does, secured from the North Dakota Agricultural Experiment Station at Fargo, were transferred to Sullys Hill, but 1 of the does, injured in crating, died shortly after being liberated.

Arrangements are being made for placing a small herd of buffalo on the reservation in the near future.

TRANSFER OF GAME.

Through cooperation with the Department of the Interior and the Forest Service 90 head of elk were transferred from Yellowstone National Park. Fifty of these were taken to national forests in Colorado, 25 to the Pisgah National Forest in North Carolina, and 15 to the Sullys Hill Game Preserve in North Dakota. No elk were transferred from Jackson Hole.

NATIONAL BIRD RESERVATIONS.

Two new national bird reservations, the San Francisco Bay Reservation in California, and the North Platte Reservation in Nebraska, were created and set aside by Executive order in August, 1916, thus increasing to 70 the number of bird reservations administered by this bureau. This includes the Niobrara, now used also as a big game preserve.

KLAMATH LAKE, OREGON.—Owing to plans for lowering the water level and reclaiming certain of the marsh lands within the reservation, conditions in general have not been entirely satisfactory. Bird life has been normal, but because of the late spring in the region, nesting and brooding have been later than usual. The Government-owned launch has been placed in first-class repair and is now available for patrolling the reservation north of the railroad embankment. A new launch, provided by the National Association of Audubon Societies, for patrolling the southern portion of the lake, was completed and placed on the lake June 30, 1917.

MALHEUR LAKE, OREGON.—As at the Klamath Lake Reservation, conditions at Malheur Lake have been unsettled, owing to the agitation of a plan to reclaim the marsh lands within the reservation by deepening the channel between Malheur and Harney Lakes and shutting off the intake of water from the Blitzen and Silvie Rivers. To date, no actual work has been undertaken on this project. If it should be carried out it would result in the destruction of one of the greatest breeding grounds for waterfowl remaining in the United States, and would deprive the State of a valuable natural asset.

BIG LAKE RESERVATION, ARKANSAS.—Temporary warden service has been maintained on this reservation since October, with very gratifying results. The Arkansas Fish and Game Commission placed a motor boat on the lake at the disposal of the warden patrolling the reservation, and this greatly improves the efficiency of the supervision exercised. The illegal practice of killing ducks and other waterfowl on and in the vicinity of the reservation and removing them by motor boats and automobiles across the Missouri boundary,

for transportation to the markets of the Middle West, has been broken up through cooperation of Federal agencies and State officials.

In a cyclone which crossed the reservation at Cotton Wood Point on May 27, seven persons were killed, two were seriously injured, and considerable damage was done to the cabins and house boats in the vicinity.

HAWAIIAN ISLANDS RESERVATION.—Reports from several sources indicate that foreign fishing parties and other poachers have been robbing the nests of birds on numerous islands of this reservation and elsewhere in the Territory. A report from Lieut. Wm. Todd, of a United States naval party which on May 24 visited the reservation, states that some ten or twelve thousand birds nest on Bird Island and that all the nests on the eastern slope and most of those on the top of the island have been robbed of eggs.

Laysan Island has not been visited during the year, but it is feared that the rabbits on this island will become so numerous as to denude it of vegetation. Undoubtedly it will be necessary to dispatch a party in the near future to exterminate these rodents, for through their destruction of the vegetation they seriously menace the existence of several species of land birds on the island.

INTERSTATE COMMERCE IN GAME.

Forty-five violations of sections 242, 243, and 244 of the Penal Code of the United States, known as the Lacey Act, were reported to the solicitor during the year. These cases included the interstate shipment of wild ducks, partridges (ruffed grouse), quail, prairie chickens, venison, squirrels, and the hides of fur-bearing animals illegally killed in or illegally shipped from the States of Colorado, Illinois, Indiana, Kansas, Kentucky, Minnesota, Mississippi, Missouri, New York, Oklahoma, Oregon, South Dakota, Tennessee, Utah, and Wisconsin. Four of the cases were for knowingly receiving game illegally shipped in interstate commerce. One of these has already been disposed of with a fine of \$400 and costs, the maximum of \$200 on each of two counts. This is one of the heaviest fines ever imposed for an offense of this character.

Thirty-two cases, including a few reported in the previous fiscal year, were disposed of by the courts, as follows: Twenty-nine by convictions and the impositions of fines and costs amounting in all to \$1,522, and one by a jail sentence of 30 days. One case was dismissed for lack of sufficient evidence and in one a verdict of not guilty was returned.

Two additional inspectors were appointed on May 1, making five now engaged in investigating violations of the Lacey Act. The country has been divided into five districts, each in charge of an inspector, and the bureau is thus able to investigate more promptly reported violations. Special attention has been given to illegal shipments of quail from a number of the Middle Western States, and 22 cases have been reported. Violations of the Lacey Act are becoming fewer each year as a result of the increased activities of the bureau and the closer cooperation of State game officials and others interested in game conservation. Only two States now permit hunting for the market—Louisiana and South Carolina.

IMPORTATION OF BIRDS AND MAMMALS.

War conditions in Europe have had a marked effect on the importation of birds and mammals during the year. The total suspension of importations from central Europe and the prohibition of the exportation of birds by Great Britain has compelled importers in the United States to rely almost entirely on South America and the Orient for live animals and birds. During the year, 413 permits were issued, as compared with 411 in 1916. Inspections numbered 112, as compared with 163 in 1916, and 97,993 birds and 4,135 mammals were imported under permits. Among these were 16,471 canaries, 35,507 miscellaneous game birds, and 46,015 nongame birds. Besides these, 7,007 birds and 339 mammals requiring no permits were admitted to entry. At Honolulu only 16 permits were issued, for the entry of 515 birds, principally pheasants. So far as known no prohibited species were brought in during the year. Many foxes for fur farming purposes have been imported from Canada, particularly from the Maritime Provinces, but the total number is less than last year.

The number of pheasants imported has reached the lowest point in 15 years, having declined from 15,412 in 1912 to 832 in 1917. European partridges are conspicuous by their absence, practically none having been imported during the year, and apparently few waterfowl are included among the entries. Canaries have decreased from 392,422 imported in 1916 to less than one-fourth of this number, and as a result the prices of these popular and formerly cheap cage birds have risen so high as to be almost prohibitive.

Traffic from the Orient has caused the port of San Francisco to assume almost as much importance as a receiving port for birds and mammals as that of New York, and most of the rare species have come through the west coast. An unusually large shipment of rare mammals and birds from Australia reached Seattle on November 9, and the specimens were ultimately distributed to several zoological parks in the East and West. The most noteworthy mammals imported were several rare kangaroos, including the island, Parry, and tree kangaroos, and black swamp wallabies; among the birds were two keas, or sheep-eating parrots (*Nestor notabilis*), from New Zealand, the first imported since 1906; and the ocellated Mallee fowl (*Alectura ocellata*). Of the species of birds imported for the first time into the United States were a pair each of the Australian white ibis (*Ibis m. strictipennis*) and straw-necked ibis (*Carphibis spinicollis*), and a New Zealand giant petrel (*Macroneotes giganteus albus*) from the Australian and New Zealand seas. Among other interesting importations were two bell birds (*Chasmorhynchus nudi-collis*) from Brazil; a babbling thrush (*Icoterus komadori*) from the Liu Kiu Islands; and several species of Philippine birds, including the spotted button quail (*Turnix ocellata*) and the Philippine rail (*Hypotaenidia torquata*).

IMPORTATION OF QUAIL FROM MEXICO.

Joint regulations governing the importation of quail from Mexico were issued by the Treasury Department and the Department of

Agriculture under date of November 13, 1916. For the first time these regulations prescribed the use of standard crates to prevent crowding the birds while in quarantine and to insure proper ventilation and sanitation. As in the previous year the ports of entry were Eagle Pass, Tex., and New York City, but all entries were made at Eagle Pass. Through cooperation with the Bureau of Animal Industry a careful and thorough inspection of the birds was made during the 10-day period of quarantine. The first permit was issued November 27, 1916, and the issue of permits was suspended on February 15, 1917. The number of quail for which permits were issued during the two months and a half was 42,973, and the number released from quarantine 32,814; as compared with permits issued for 12,989, and the importations of 8,000 in 1916. The total number brought in last season was much larger than in any previous year, and special efforts were made by some of the importers to facilitate in every possible way the handling of the birds prior to quarantine and to insure prompt shipment after release. In two cases, State game commissioners arranged for the shipment of their birds from Eagle Pass in special cars in charge of their own employees. While the losses during quarantine were small and only a few cases of quail disease were detected near the close of the season, heavy losses from other causes were reported after the birds reached their destination. Two States which received nearly half the total number of quail reported losses of about 50 per cent. Attempts to handle quail in carload lots can hardly be considered successful as yet, although the losses en route are very small.

At the rate importations were made last season the available supply of Mexican quail in the region adjoining the Rio Grande will probably last but a few years. Under the circumstances, it is a serious question whether better results will not be secured and more actual progress made in restocking if the birds are handled in smaller lots and given more careful attention after arrival than if they continue to be handled in shipments of several thousand each.

INFORMATION CONCERNING GAME LAWS AND GAME.

The regular annual publications, including a directory of game officials, the seventeenth annual summary of game laws, and a general poster showing open seasons for game, were issued, and the demand for them continues to be large. New game laws passed by the various States have been carded and the index of game legislation has been kept up to date as fast as the new laws are received; under the latter head is included the preparation of a subject index and memoranda on some of the more important phases.

Investigations were begun the last part of the year to determine the value of game as a national asset. No comprehensive information on this subject is now available and the need for it has become increasingly evident. The work is being done with great care, and the data already gathered indicate that the results will prove of much importance not only to hunters but to State officials and to the States, as showing the necessity for better laws and better enforcement in conserving one of our important national resources.

FEDERAL MIGRATORY-BIRD LAW.

As experience has been gained in the administration of the migratory-bird law, act of March 4, 1913 (37 Stat., 828, 847), it has become necessary to readjust some of the prescribed seasons under the regulations first adopted by the department on October 1, 1913. Amended regulations were prepared and promulgated October 1, 1914, and again on August 21, 1916. These amendments eliminated certain provisions which experience proved were not essential for the conservation of migratory birds and prescribed seasons which were generally more satisfactory to State game officials and sportsmen, and at the same time gave the birds adequate protection.

For administrative purposes the United States is divided into 13 districts, now under the supervision of 16 inspectors, who, with the assistance of 186 Federal wardens, enforce the regulations in the various States. During the year the commissions of 33 Federal wardens were terminated and 29 new wardens were appointed.

The district inspectors and Federal wardens reported 208 cases of violation of the regulations, which make a total of 859 cases to date. Since the law became effective prosecutions have been had in 29 cases, resulting in convictions and impositions of penalties in all but 5. Fines were paid in 18 and suspended in 6 cases. Twenty-five cases are now pending in district courts in various parts of the country; and the transmission to the Department of Justice of 805 cases, including those reported this year, is withheld pending the decision of the United States Supreme Court in the case of *The United States v. Harvey C. Shauver*, involving the constitutionality of the law.

That the violations reported by no means approximate the number that have occurred is to be expected and is due to the impossibility in many cases under the law of securing evidence sufficient to convict. Possession of wild fowl during the closed season is not a violation under the Federal act, and there must be evidence of actual shooting or capture on which to base a prosecution. Furthermore, inspectors and wardens appointed under authority of the law have no power of arrest, and hence many violators escape.

Notwithstanding the difficulties attending enforcement, the present law is very generally observed, and communications received from game and fish commissioners and other persons contain incontrovertible evidence that since the law became effective a very marked increase in the number of waterfowl and shorebirds has been noted in most of the States; that wild fowl have become unusually tame in spring; and that many thousands of waterfowl are breeding in certain localities where they had not nested for many years. The consensus of opinion attributes these greatly improved conditions to the abolition of spring shooting and the general observance of the regulations.

Owing to the limited number of inspectors available, it has been necessary to confine their activities to States where they were most needed, leaving many States with little or no supervision. In many instances the State authorities have cooperated and have rendered efficient assistance. State legislatures have made progress in line with the Federal law and regulations, and during the year 18 States amended their laws to the extent of making the open seasons on

waterfowl conform with the open seasons under the Federal regulations; in 6 other States legislation was enacted to unify the laws, and practical uniformity with the regulations was thus secured.

A treaty between the United States and Great Britain for the protection of migratory birds was concluded at Washington August 16, 1916, and was ratified by the Senate August 29 and by Great Britain October 20; ratifications thereof were exchanged December 7 and it was proclaimed by the President December 8, 1916. A bill to give effect to this treaty was introduced in the short session of the Sixty-fourth Congress and was reintroduced at the extra session of the Sixty-fifth Congress, where it is now pending.

That the necessity of Federal protection of migratory birds is now generally recognized and that the results accomplished under the law and regulations have been highly satisfactory are demonstrated by the action of the National Association of Game and Fish Commissioners in endorsing unanimously the bill to give effect to the treaty and in urging its immediate passage by Congress.

These results following so soon after the enactment of the law have proved the efficacy of Federal protection of migratory birds and serve to show what may be accomplished under a law, such as the treaty enabling act, conferring the additional powers necessary to its effective enforcement.

REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF ACCOUNTS AND DISBURSEMENTS,
Washington, D. C., September 27, 1917.

SIR: I have the honor to submit herewith a report of the work of the Division of Accounts and Disbursements for the fiscal year ended June 30, 1917.

Respectfully,

A. ZAPPONE,
Chief of Division.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

CHARACTER OF WORK.

The chief of the division and disbursing clerk is charged by the Secretary of Agriculture with the duty of preparing all requisitions for the advance of public funds from the appropriations for the Department of Agriculture to the disbursing clerk and to special disbursing agents charged with the disbursement of public funds; the keeping of accounts and appropriations ledgers relating to the advance and disbursement of all items of appropriations; and the examination and payment of all vouchers and pay rolls submitted from the various offices, bureaus, and services of the department. He performs such other duties as may be prescribed by the Secretary.

WORK OF THE YEAR.

APPROPRIATIONS, EXPENDITURES, ETC.

To carry on the work of the Department of Agriculture during the fiscal year ended June 30, 1917, Congress appropriated \$24,948,852 in the agricultural act for that fiscal year, in addition to which permanent annual appropriations, special appropriations, deficiency appropriations, and the appropriation for printing and binding were available, amounting to \$12,240,000, making a total of \$37,188,852, of which sum \$28,056,272.03 was disbursed prior to the close of the year, leaving a balance at the end thereof of \$9,132,579.97, which is nearly all covered by outstanding liabilities.

Supplemental accounts for the year 1916 were also paid, amounting to \$1,530,876.92.

On June 30, 1917, the unexpended balances for the year 1915, amounting to \$797,207.07, were finally covered into the Treasury to the "Surplus fund."

There were received, examined, and paid by this office 129,980 vouchers and pay rolls, which required the issuance of 231,149 checks on the Treasurer of the United States.

There were also sent to the Treasury Department for payment 7,137 accounts.

LOST CHECKS.

During the year 144 checks were lost in transit through the mails or by the payees, and were duplicated by this office.

PUBLIC MONEYS RECEIVED FROM VARIOUS SOURCES.

There were received from various sources and deposited in the Treasury to the credit of the proper funds the following sums:

Miscellaneous expenses:

Telegrams over Government lines.....	\$5,804.46
Sale of cotton standards.....	2,679.40
Cost of cotton-futures disputes.....	1,664.35
Sale of loose cotton.....	29,915.47
Cost of grain standards appeals.....	775.00
Sale of photo prints and lantern slides.....	741.14
Sale of hearings.....	111.60
Sale of card indexes.....	291.92
Sale of other miscellaneous Government property.....	52,408.55
Sales of products, agricultural station, Hawaii.....	130.50
Sales of products, agricultural station, Alaska.....	1,527.88
Sales of products, agricultural station, Porto Rico.....	830.27
Sales of products, agricultural station, Guam.....	286.97

Repayments to appropriations:

Mileage, mileage books, etc.....	13,425.70
Transfers from other departments for work done and supplies furnished.....	73,762.20

Total..... 184,355.41

STATEMENT OF APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES
FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Fiscal years 1839 to 1904, inclusive.]

Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.	Fiscal year.	Amount appropriated.	Amount disbursed.	Amount unexpended.
1839..	\$1,000.00	1,000.00		1872..	\$197,070.00	\$195,977.25	\$1,092.75
1840..				1873..	202,440.00	201,321.22	1,118.78
1841..				1874..	257,690.00	233,765.78	23,924.22
1842..	1,000.00	1,000.00		1875..	337,380.00	321,079.83	16,300.17
1843..				1876..	249,120.00	198,843.64	50,276.36
1844..	2,000.00	2,000.00		1877..	194,688.96	188,206.19	6,482.77
1845..	2,000.00	2,000.00		1878..	198,640.00	197,634.94	1,005.06
1846..	3,000.00	3,000.00		1879..	206,400.00	206,360.00	40.00
1847..	3,000.00	3,000.00		1880..	199,500.00	198,361.72	1,138.28
1848..	4,500.00	4,500.00		1881..	275,490.31	267,608.84	7,881.47
1849..	3,500.00	3,500.00		1882..	363,011.05	354,482.39	8,528.66
1850..	5,500.00	5,500.00		1883..	456,396.11	438,941.72	17,454.39
1851..	5,500.00	5,500.00		1884..	416,641.10	413,618.09	3,023.04
1852..	5,000.00	5,000.00		1885..	655,930.25	558,934.89	96,995.36
1853..	5,000.00	5,000.00		1886..	677,973.22	519,196.11	158,777.11
1854..	10,000.00	10,000.00		1887..	657,641.81	628,287.14	29,354.67
1855..	50,000.00	50,000.00		1888..	1,027,219.06	1,011,282.62	15,936.44
1856..	30,000.00	30,000.00		1889..	1,134,480.60	1,033,590.22	100,890.38
1857..	75,000.00	75,000.00		1890..	1,170,139.11	1,971,823.62	198,315.49
1858..	63,500.00	63,157.25	\$342.75	1891..	1,372,049.21	1,266,277.36	105,771.85
1859..	60,000.00	60,000.00		1892..	2,303,655.75	2,253,262.29	50,393.46
1860..	40,000.00	40,000.00		1893..	2,540,060.72	2,355,480.25	184,630.47
1861..	60,000.00	60,000.00		1894..	2,603,855.58	1,977,469.28	626,386.30
1862..	64,000.00	63,704.21	295.79	1895..	2,506,915.30	2,021,030.38	485,884.92
1863..	80,000.00	80,000.00		1896..	2,534,013.22	2,094,916.42	439,096.80
1864..	199,770.00	189,270.00	10,500.00	1897..	2,448,763.53	2,348,512.98	100,250.55
1865..	112,304.05	112,196.55	107.50	1898..	2,487,902.00	2,425,510.44	62,391.56
1866..	167,787.82	167,787.82		1899..	2,829,702.00	2,827,795.65	1,906.35
1867..	199,100.00	199,100.00		1900..	3,006,022.00	2,947,603.42	58,418.58
1868..	279,020.00	277,094.34	1,925.66	1901..	3,304,265.97	3,239,137.39	65,128.58
1869..	172,593.00	172,593.00		1902..	3,922,780.51	3,902,675.79	20,104.72
1870..	156,440.00	151,596.93	4,843.07	1903..	5,015,846.00	4,734,230.84	281,615.16
1871..	188,180.00	188,876.81	1,308.19	1904..	5,025,024.01	4,969,311.64	55,712.37

STATEMENT OF APPROPRIATIONS, DISBURSEMENTS, AND UNEXPENDED BALANCES FOR THE UNITED STATES DEPARTMENT OF AGRICULTURE.

[Fiscal years 1905 to 1917, inclusive.]

Fiscal year.	Agricultural appropriation act.			Other acts.			Total.		
	Appropriated.	Disbursed.	Unexpended.	Permanent annual appropriations, deficiency acts, special acts, and printing and binding under the sundry civil act.	Disbursed.	Unexpended.	Appropriated.	Disbursed.	Unexpended.
1905	\$5,902,040.00	\$5,826,365.63	\$75,674.37	\$1,207,642.62	\$1,207,642.62	.....	\$7,109,682.62	\$7,034,008.25	\$75,674.37
1906	6,882,600.00	6,696,510.02	186,179.98	1,955,219.98	1,955,219.98	.....	8,837,902.60	8,641,729.98	196,172.62
1907	9,832,940.00	9,598,845.02	234,094.98	3,146,583.98	2,310,401.66	\$836,092.32	13,079,523.58	11,579,338.68	1,500,184.90
1908	9,447,200.00	9,279,955.38	167,244.62	3,590,512.62	3,315,546.80	274,965.82	13,037,902.62	12,598,802.25	439,100.37
1909	11,672,108.00	11,478,698.40	193,409.60	4,481,428.74	4,368,528.79	112,899.95	18,153,534.74	17,847,470.48	306,064.26
1910	12,945,038.00	12,647,918.27	297,119.73	4,120,374.35	4,056,552.21	63,822.14	17,115,410.35	16,704,470.48	410,939.87
1911	13,487,638.00	13,184,652.22	302,985.78	7,400,813.28	7,240,115.70	160,697.58	20,888,449.28	20,424,767.92	463,681.36
1912	16,900,016.00	15,930,970.55	969,045.45	5,502,285.11	5,454,328.84	47,956.27	22,402,301.11	20,885,299.39	1,517,001.72
1913	16,651,498.00	16,005,448.40	646,049.60	8,525,668.65	8,481,328.50	44,340.15	25,177,164.68	24,498,776.90	678,387.78
1914	17,986,945.00	17,297,761.46	689,183.54	6,462,879.37	6,393,252.94	69,626.43	24,449,824.37	23,601,994.40	847,829.97
1915	19,861,832.00	19,408,375.18	453,456.82	6,974,602.55	6,837,656.98	336,945.56	26,840,434.55	26,046,032.17	794,402.38
1916	22,971,782.00	20,388,732.68	2,583,049.32	6,047,921.98	1,931,426.17	4,116,495.81	29,019,703.98	22,320,158.85	6,699,545.13
1917	24,945,852.00	21,965,357.38	2,980,494.62	12,240,000.00	6,390,914.65	5,849,085.35	37,188,833.00	28,056,272.03	9,132,560.97

REPORT OF THE CHIEF OF THE DIVISION OF PUBLICATIONS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
DIVISION OF PUBLICATIONS,
Washington, D. C., September 20, 1917.

SIR: I have the honor to submit herewith a report on the operations of the Division of Publications for the fiscal year ended June 30, 1917.

Respectfully,

JOS. A. ARNOLD,
Editor and Chief.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

SUMMARY.

The new publication work of the year comprised 1,132 bulletins, reports, separates, periodicals, and miscellaneous documents, the editions of which aggregated 22,987,335 copies. Of this number 138 publications were ordered through the Weather Bureau and 994 through the Division of Publications.

The total number of documents of all kinds aggregated 47,023,635 copies, of which 24,036,300 copies were reprints of earlier publications.

The number of new department bulletins contributed by the various bureaus, divisions, and offices aggregated 172, of which 1,320,200 copies were ordered.

The 12 department bulletins reprinted aggregated 57,500 copies.

There were 84 new Farmers' Bulletins, of which the editions ordered amounted to 4,515,000 copies, and reprints were ordered of 266 Farmers' Bulletins, aggregating 17,507,500 copies. Thus the number of copies of Farmers' Bulletins ordered reached the total of 22,022,500, exceeding the record for any previous year.

Of the serial publications 11,072,100 copies were ordered.

Of blanks, administrative orders, circular letters, notices, etc., cards, blank books, letterheads, posters, labels, maps, compilations, manuals, regulations, etc., the number of copies printed aggregated 61,170,713 copies, making the total amount of printed matter of every description 108,204,348 copies.

WORK OF THE YEAR.

ALLOTMENTS AND EXPENDITURES.

The appropriation for printing and binding was \$600,000; the amount expended by the Weather Bureau was \$34,999.16 and by this division \$564,993.66, leaving a balance of \$7.18.

The number of requisitions on the Public Printer for printing and binding of every description aggregated 4,140, as compared with 4,010 issued during the preceding year.

Of the department's appropriation of \$600,000 for printing and binding, not exceeding \$177,500 was provided for Farmers' Bulletins, and not exceeding \$47,000 for the Weather Bureau.

The appropriation for salaries for the 178 employees of the Division of Publications was \$177,400 and that for miscellaneous expenses \$20,250. The actual expenditures of this division were as follows:

Salaries of employees (all on statutory roll).....	\$172, 785. 81
Miscellaneous expenses for materials, supplies, etc.....	19, 688. 56
Total.....	192, 474. 37

EXPENDITURES FOR PRINTING AND BINDING.

The aggregate expenditures from the regular appropriation for printing and binding were \$599,992.82. The following statement shows the amounts expended for the various classes of publications and the percentages of the total amount used for each class:

Expenditures for printing and binding, by classes, and the percentage of the same to the total expenditures, 1917.

Class.	Amount.	Per cent.
Farmers' Bulletins.....	\$163, 529. 96	27. 26
Publications and department bulletins.....	81, 054. 50	13. 51
Periodical publications.....	95, 483. 92	15. 91
Blank forms.....	43, 615. 02	7. 27
Congressional.....	69, 758. 86	11. 63
Miscellaneous administrative circulars, orders, decisions, etc.....	45, 302. 31	7. 55
Separates and unnumbered pamphlets.....	22, 221. 66	3. 70
Binding.....	16, 224. 98	2. 70
Index cards.....	11, 755. 78	1. 96
Blank books.....	10, 656. 25	1. 78
Letterheads.....	10, 797. 38	1. 80
Posters, placards, labels, maps, etc.....	26, 016. 10	4. 34
Compilation of laws, manuals, fiscal regulations, etc.....	3, 268. 45	. 54
Envelopes.....	295. 73	. 06
Memoranda sheets.....	11. 90	
Total.....	599, 992. 82	100. 00

As usual, at the close of the fiscal year, the Government Printing Office had a considerable amount of work that was either not yet undertaken or not completed. The following statement shows the expenditures for printing and binding for the various bureaus and the estimated cost of work not completed and therefore carried forward to the next year:

Expenditures for printing and binding, by bureaus, divisions, and offices, for the fiscal year ended June 30, 1917, and estimated cost of work ordered but not completed.

Bureau, division, or office.	Bills for completed work.	Estimates for incom- pleted work carried to fiscal year 1918.	Total.
Division of Accounts and Disbursements.....	\$854.26	\$388.07	\$1,142.33
Bureau of Animal Industry.....	19,221.14	5,449.41	24,670.55
Bureau of Biological Survey.....	3,203.59	454.45	3,658.04
Bureau of Chemistry.....	13,326.30	682.60	14,008.90
Bureau of Entomology.....	13,717.44	381.07	14,098.51
States Relations Service.....	51,675.60	5,879.99	57,555.59
Forest Service.....	23,843.35	2,382.80	26,226.14
Lumber Industry.....	7,868.87	-----	7,868.87
Library.....	8,707.52	2,823.34	11,530.86
Division of Publications.....	13,970.65	202.49	14,173.14
Office of Public Roads and Rural Engineering.....	12,244.00	267.80	12,511.80
Bureau of Soils.....	44,304.64	2,423.46	46,728.10
Bureau of Crop Estimates.....	33,777.63	1,226.43	35,004.06
Office of the Secretary.....	91,000.70	9,145.44	100,146.14
Reserve fund.....	5,441.45	-----	5,441.45
Office of Solicitor.....	389.92	422.54	812.46
Insecticide and Fungicide Board.....	1,460.47	34.41	1,494.88
Federal Horticultural Board.....	2,287.79	47.69	2,335.48
Office of Markets and Rural Organization.....	15,291.87	921.88	16,213.75
Office of Farm Management.....	4,104.16	33.79	4,137.95
Agricultural Atlas.....	6,505.44	-----	6,505.44
Bureau of Plant Industry.....	28,266.89	1,043.47	29,310.36
Weather Bureau.....	34,999.16	1,615.24	36,614.40
Total.....	436,462.84	35,726.46	472,189.30
Farmers' Bulletins.....	163,529.98	25,910.67	189,440.65
Grand total.....	599,992.82	61,637.13	661,629.95

SUMMARY OF EXPENDITURES FOR JOB WORK AND BINDING AND FOR REGULAR PUBLICATIONS, MISCELLANEOUS DOCUMENTS, CIRCULARS, AND REPORTS.

The following statement shows the total expenditures from the regular fund for bureaus, divisions, and offices, classified according to the kind and character of the work. While the Division of Publications does not have supervision of the appropriation of the Weather Bureau, a statement of expenditures for that bureau, being necessary to show the entire expenditure for the department's printing, is included.

Expenditures for job work and binding and for regular publications, miscellaneous documents, circulars, and reports (arranged by bureaus, divisions, and offices) during the fiscal year ended June 30, 1917.

Bureau, division, or office.	Job work and binding.	Regular publications, miscellaneous documents, circulars, and reports.	Total.
Division of Accounts and Disbursements.....	\$329.90	\$24.36	\$354.26
Bureau of Animal Industry.....	10,490.24	8,730.90	19,221.14
Bureau of Biological Survey.....	2,004.21	1,199.38	3,203.59
Bureau of Chemistry.....	3,705.82	9,620.48	13,326.30
Bureau of Entomology.....	6,046.57	7,670.87	13,717.44
States Relations Service.....	10,460.20	41,215.40	51,675.60
Forest Service.....	13,055.23	10,788.12	23,843.35
Lumber Industry.....		7,868.87	7,868.87
Library.....	8,649.38	58.14	8,707.52
Division of Publications.....	1,709.87	12,260.78	13,970.65
Office of Public Roads and Rural Engineering.....	1,420.87	10,823.13	12,244.00
Bureau of Soils.....	267.97	44,036.67	44,304.64
Bureau of Crop Estimates.....	10,478.33	23,299.30	33,777.63
Office of Secretary.....	12,262.07	78,738.63	91,000.70
Reserve fund.....	2,334.29	3,107.16	5,441.45
Office of Solicitor.....	176.88	213.04	389.92
Insecticide and Fungicide Board.....	215.75	1,244.72	1,460.47
Federal Horticultural Board.....	982.39	1,305.40	2,287.79
Office of Markets and Rural Organization.....	4,786.82	10,505.05	15,291.87
Office of Farm Management.....	550.90	3,553.26	4,104.16
Agricultural Atlas.....	6,505.44		6,505.44
Bureau of Plant Industry.....	8,112.40	20,154.49	28,266.89
Weather Bureau.....	14,327.61	20,671.55	34,999.16
Total.....	119,373.14	317,080.70	436,453.84
Farmers' Bulletins.....			163,529.98
Grand total.....	119,373.14	317,080.70	599,992.82

DETAILED STATEMENT OF EXPENDITURES FOR PRINTING AND BINDING BY CLASSES OF WORK, FOR EACH BUREAU, DIVISION, AND OFFICE, 1917.

The following tabular statement shows the actual expenditures for printing and binding on account of the various bureaus, divisions, and offices, chargeable against the regular appropriation of \$600,000. The classes of work for which the expenditures were incurred and the amount or number of copies ordered are given. The expenditures include the final charges on work ordered in 1916 but not completed in that year and the first charges on work ordered in the fiscal year 1917 but completed only in part, the final charges for which will be defrayed from the appropriation for 1918. The copies given, therefore, represent more nearly the number ordered than in every case the number actually received. The figures given in connection with the distribution of documents under the heading "Document section" present more accurately the number of bulletins, documents, etc., actually received as well as distributed.

Classified expenditures for printing and binding (arranged by bureaus, divisions, and offices) for the fiscal year ended June 30, 1917.

Bureau, division, or office.	Total.		Farmers' Bulletins.		Publications and department bulletins.		Periodical publications.		Blank forms.	
	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.
Office of Secretary.....	34, 026, 152	\$254, 330.68	22, 022, 500	\$163, 529.98	100, 000	\$950.97	6, 785, 000	\$49, 398.44	2, 243, 700	\$3, 474.60
Reserve fund.....	998, 500	5, 441.45			79, 000	3, 121.20			41, 500	118.34
Office of Farm Management.....	197, 373	4, 104.16								
Agricultural Atlas.....	19, 750	6, 505.44								
Office of Solicitor.....	110, 108	386.92			500	12.85			11, 000	34.77
Bureau of Plant Industry.....	6, 404, 559	28, 266.89			819, 000	11, 616.72			2, 204, 150	2, 125.07
Bureau of Soils.....	350, 099	44, 304.64			9, 000	172.71			25, 000	48.84
Bureau of Animal Industry.....	12, 910, 318	19, 221.14			153, 500	2, 552.17			3, 948, 400	4, 254.20
Weather Bureau.....	10, 148, 044	34, 996.16			17, 945	7, 985.60	19, 000	7, 186.48	10, 036, 800	10, 750.78
States Relations Service.....	9, 905, 508	51, 675.60			269, 200	7, 313.10	180, 000	15, 187.45	1, 233, 572	2, 081.41
Forest Service.....	4, 621, 061	23, 843.35			209, 700	6, 817.88			3, 193, 400	5, 771.55
Lumber Industry.....	195, 000	7, 868.87			195, 000	7, 868.87				
Bureau of Crop Estimates.....	7, 583, 321	33, 777.63			62, 000	2, 853.70	1, 911, 500	19, 296.36	3, 778, 475	7, 415.84
Bureau of Chemistry.....	2, 360, 263	13, 326.30			66, 500	3, 140.43			659, 615	1, 410.09
Bureau of Entomology.....	1, 837, 123	13, 717.44			120, 000	6, 410.48			639, 500	186.61
Library.....	9, 972, 158	8, 707.52							213, 500	394.76
Division of Publications.....	9, 536, 855	13, 970.65			5, 000	38.80	2, 176, 500	4, 412.19	1, 113, 034	597.10
Office of Markets and Rural Organization.....	3, 357, 711	15, 291.87			423, 200	9, 089.52			1, 000, 950	1, 452.26
Federal Horticultural Board.....	600, 095	2, 287.79							290, 400	645.76
Federal Biological Survey.....	844, 896	3, 205.59			17, 000	805.36			283, 056	573.89
Office of Public Roads and Rural Engineering.....	689, 358	12, 244.00			148, 000	10, 299.14			239, 043	658.71
Division of Accounts and Disbursements.....	229, 823	854.26							194, 607	775.64
Insecticide and Fungicide Board.....	206, 223	1, 460.47							102, 200	141.80
Total.....	108, 204, 348	599, 992.82	22, 022, 500	163, 529.98	2, 684, 545	81, 054.50	11, 072, 100	95, 483.92	31, 518, 902	43, 615.02

Classified expenditures for printing and binding (arranged by bureaus, divisions, and offices) for the fiscal year ended June 30, 1917—Continued.

Bureau, division, or office.	Congressional.		Miscellaneous administrative circulars, orders, decisions, notices, etc.		Separates and unnumbered pamphlets.		Binding.		Index cards.	
	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.
Office of Secretary.	42,491	\$18,763.02	1,639,557	\$8,815.35	51,026	\$1,716.77	20,303	\$496.10	86,425	\$382.61
Reserve fund.....	2,502	34.66	658,000	1,038.37	7,500	171.12	5,046	20.69	1,000	11.65
Office of Farm Management.....	2,002	85.41	8,001	226.28	146,400	4,873.17	16,191	1,016.98	15,500	24.30
Office of Solicitor.....	12,502	104.21	25,000	114.78	7,600	329.42	1,023	38.87	1,417,450	1,777.48
Bureau of Plant Industry.....	104,885	43,532.03	414,101	3,560.39	96,000	765.62	1,687	894.21	1,152,700	882.44
Bureau of Soils.....	2,503	232.76	5,006,881	5,150.35	35,600	1,317.84	2,256	2,775.85	6,000	22.73
Bureau of Animal Industry.....	1,009	4,178.63	3,665,801	14,430.00	60,400	2,298.77	2,344	1,287.73	3,614,150	3,136.69
Weather Bureau.....	3,502	1,981.08	105,001	1,144.64	32,500	517.98	8,826	1,708.52	543,800	1,251.40
States Relations Service.....	2,804	216.23	315,501	423.99	50,000	693.31	315	296.05	151,500	168.79
Bureau of Crop Estimates.....	2,502	51.89	380,501	6,303.79	6,000	90.18	4,737	463.34	95,800	256.42
Bureau of Chemistry.....	1,504	61.53	20,001	113.14	41,600	1,085.72	1,128	184.32	122,400	244.43
Bureau of Entomology.....	1,502	56.63	1	1.51	5,132,000	7,648.36	15,940	6,994.73	732,200	1,499.86
Library.....	1,502	116.88	15,001	44.55	57,000	353.77	108	77.78	935,575	855.40
Division of Publications.....	9,506	132.66	103,501	899.10	2,005	337.05	2,005	337.05	322,000	557.92
Office of Markets and Rural Organization.....	2,502	51.00	103,601	1,254.40	12,100	117.72	27	33.16	18,550	68.23
Federal Horticultural Board.....	2,002	49.33	24,501	226.97	13,060	211.91	216	4.53	143,800	222.69
Bureau of Biological Survey.....	2,502	49.63	4,201	292.46	13,060	211.91	97	127.07	126,550	298.86
Office of Public Roads and Rural Engineering.....	2,202	16.09	1,002	8.27					24,000	36.50
Division of Accounts and Disbursements.....	2,502	12.26	61,001	1,282.46					30,500	56.33
Insecticide and Fungicide Board.....										
Total.....	201,427	69,753.86	12,356,155	45,302.31	5,748,796	22,221.66	81,249	16,224.98	9,559,400	11,755.78

Bureau, division, or office.	Blank books.		Letterheads.		Posters, placards, labels, maps, etc.		Compilation of laws, manuals, fiscal regulations, etc.		Envelopes.		Memoranda sheets.	
	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.	Copies.	Cost.
Office of Secretary.....	30,100	\$1,202.14	191,500	\$654.70	1,097,350	\$5,987.45	5,000	\$45.05	11,200	\$74.47		
Reserve fund.....					240,000	2,334.20	500	1,097.83				
Office of Farm Management.....	1,200	141.64	50,000	105.35	6,670	6,505.44						
Agricultural Atlas.....					19,750	7.50						
Office of Solicitor.....			51,000	80.62	60	624.00			210,750	221.26		
Bureau of Plant Industry.....	8,165	824.61	950,100	1,573.00	205,750	36.83						
Bureau of Soils.....	150	38.79	59,000	22.59	128,440	2,276.47						
Bureau of Animal Industry.....	54,677	1,347.04	1,980,000	1,335.88	514,970	553.19						
Weather Bureau.....	234	225.06			7,100	453.94						
States Relations Service.....	305,248	2,537.08	391,000	233.35	119,291	963.57	44,500	2,091.39				
Forest Service.....	38,950	2,855.12	347,000	503.07	94,600	513.38						
Bureau of Crop Estimates.....			1,317,500	2,083.27	4,028	132.79	1,000	34.19			2,000	\$11.90
Bureau of Chemistry.....	991	407.80	1,003,000	1,003.48	185,147	4,122.53						
Bureau of Entomology.....	6,000	898.40	132,500	210.13	852,490	1.88						
Library.....			10,000	16.30	15	4.38						
Division of Publications.....	100	16.60	150,000	153.61	35	378.13						
Office of Markets and Rural Organization.....	2,500	99.98	1,400,000	1,961.48	37,060	155.21						
Federal Horticultural Board.....			40,000	77.03	140,015	737.44						
Bureau of Biological Survey.....			300,000	465.66	82,721	48.76						
Office of Public Roads and Rural Engineering.....	700	69.99	150,000	217.48	8,205	1.50						
Division of Accounts and Disbursements.....			10,000	16.26	20	2.50						
Insecticide and Fungicide Board.....			10,000	15.12								
Total.....	450,015	10,656.25	8,542,600	10,797.38	3,691,719	26,016.10	51,000	3,268.45	221,950	295.73	2,000	11.90

Total appropriations.....	\$600,000.00
Total expenditures:	
Exclusive of Farmers' Bulletins.....	\$436,462.84
Farmers' Bulletins.....	163,539.98
Balance unexpended.....	599,997.82
	7.18

NOTE.—The Division of Publications does not have supervision of the appropriation for that bureau, however, is included, in order to show the total expenditures for printing and binding for the department.

STATISTICS OF PUBLICATION WORK.

The following statement shows the contributions of new publications to the departmental series of bulletins and the Farmers' Bulletins series by the various bureaus, divisions, and offices.

Contributions by the various bureaus, divisions, and offices to the department series of bulletins and to the Farmers' Bulletin series issued during the year.

Bureau, division, or office.	New department bulletins.		New Farmers' Bulletins.	
	Number.	Copies.	Number.	Copies.
Bureau of Animal Industry.....	8	38,000	17	810,000
Bureau of Biological Survey.....	2	10,000	6	275,000
Bureau of Chemistry.....	8	33,000		
Bureau of Entomology.....	25	99,000	14	440,000
Office of Farm Management.....	16	68,000	7	300,000
Forest Service.....	16	132,000	2	60,000
Bureau of Plant Industry.....	44	433,500	27	1,335,000
Office of Public Roads and Rural Engineering.....	17	103,000		
Bureau of Soils.....	2	6,000		
Bureau of Crop Estimates.....	4	20,000		
Office of Markets and Rural Organization.....	14	233,700	5	375,000
Office of Secretary.....			1	250,000
States Relations Service.....	16	144,000	5	670,000
Weather Bureau.....				
Total.....	172	1,320,200	84	4,515,000

The following statement shows the total number of copies of publications issued during the last 28 years:

Copies of publications of all kinds, new and reprints, issued by the department, 1890-1917, inclusive.

Year.	Number of copies.	Year.	Number of copies.	Year.	Number of copies.	Year.	Number of copies.
1890.....	1,904,300	1898.....	6,280,365	1906.....	13,488,527	1914.....	33,186,392
1891.....	2,833,933	1899.....	7,075,975	1907.....	16,745,910	1915.....	36,075,561
1892.....	2,348,797	1900.....	7,152,428	1908.....	16,875,516	1916.....	39,098,239
1893.....	3,446,181	1901.....	7,889,281	1909.....	17,190,345	1917.....	47,023,635
1894.....	3,169,310	1902.....	10,586,580	1910.....	25,190,465	Total...	451,991,217
1895.....	4,100,660	1903.....	11,698,564	1911.....	27,594,877		
1896.....	6,561,700	1904.....	12,421,386	1912.....	34,678,557		
1897.....	6,541,210	1905.....	12,475,157	1913.....	33,356,366		

Summary of new publications and reprints of bulletins, reports, separates, miscellaneous printing, etc.

Class.	Number.	Copies.
NEW PUBLICATIONS.		
Department bulletins.....	172	1,820,200
Farmers' Bulletins.....	84	4,515,000
Soil surveys.....	87	57,000
Secretary's Report to the President.....	1	5,000
Secretary's Report (summary).....	1	5,500
Farm Management Report.....	1	2,500
Annual reports, Department of Agriculture.....	1	400
Yearbook.....	1	30,000
Yearbook separates.....	67	274,500
Miscellaneous reports.....	5	145,000
Journal of Agricultural Research.....	48	95,000
Journal of Agricultural Research separates.....	112	130,481
Federal Horticultural Board.....	33	111,100
Insecticide Board.....	5	47,500
Posters.....	13	1,364,000
Miscellaneous publications, Office of Secretary.....	6	67,250
Solicitor.....	3	4,500
Circulars, Office of Secretary.....	16	1,670,000
Weekly News Letter.....	53	5,955,000
Miscellaneous publications of the bureaus.....	315	6,918,350
Weather Bureau.....	138	251,054
Total of new publications.....	1,132	22,987,335
REPRINTS.		
Department bulletins.....	12	57,500
Farmers' Bulletins.....	266	17,507,500
Yearbook separates.....	7	14,000
Miscellaneous bureau publications.....	105	6,457,300
Total reprints.....	390	24,036,300
Total of new publications and reprints.....	1,522	47,023,635

In this table, as well as in others, the total editions ordered are given, although in some cases, particularly as regards Farmers' Bulletins, the editions remained undelivered at the close of the year.

FARMERS' BULLETINS.

During the year 84 new Farmers' Bulletins were issued, exceeding the number published during any preceding fiscal year. The first editions of these new bulletins aggregated 4,515,000 copies. Reprints ordered of these and of earlier bulletins totaled 17,507,500 copies, making an aggregate of 22,022,500 copies of Farmers' Bulletins ordered during the year, although the number actually delivered by the Public Printer was 15,177,800 copies.

During the latter part of the year some of the Farmers' Bulletins were utilized to a considerable extent in connection with the department's efforts to increase the food supply of the country. Notably among them were No. 839, Home Canning by the One-Period Cold-Pack Method, and No. 841, Home and Community Drying of Fruits and Vegetables, aggregating 1,250,000 and 1,100,000 copies, respectively; No. 818, The Small Vegetable Garden, the editions of which aggregated 1,000,000 copies, while of an old bulletin, No. 255, The Home Vegetable Garden, 260,000 copies were reprinted.

Following is a list of new Farmers' Bulletins issued during the year:

List of new Farmers' Bulletins issued during the year ended June 30, 1917, with the size of the first editions.

No. of bulletin.	Title.	Copies.
729	Corn Culture in the Southeastern States.....	30,000
736	Ginseng Diseases and Their Control.....	60,000
740	House Ants: Kinds and Methods of Control.....	65,000
741	The Alfalfa Weevil and Methods of Controlling It.....	50,000
743	The Feeding of Dairy Cows.....	90,000
744	The Preservative Treatment of Farm Timbers.....	30,000
745	Waste Land and Wasted Land on Farms.....	60,000
746	The Farmer's Income.....	100,000
747	Grasshoppers and Their Control in Relation to Cereal and Forage Crops.....	30,000
748	A Simple Steam Sterilizer for Farm Dairy Utensils.....	30,000
749	Grains for the Montana Dry Lands.....	60,000
750	Roses for the Home.....	125,000
751	Peanut Oil.....	30,000
752	The Fall Army Worm, or "Grass Worm," and Its Control.....	20,000
753	Commercial Handling, Grading, and Marketing of Potatoes.....	100,000
754	The Bedbug.....	30,000
755	Common Birds of Southeastern United States in Relation to Agriculture.....	50,000
756	Culture of Rye in the Eastern Half of the United States.....	30,000
757	Commercial Varieties of Alfalfa.....	60,000
758	Muscadine Grape Sirup.....	45,000
759	"White Ants" as Pests in the United States, and Methods of Preventing Their Damage.....	30,000
760	How to Attract Birds in Northwestern United States.....	30,000
761	Management of Muck-Land Farms in Northern Indiana and Southern Michigan.....	30,000
762	The False Chinch Bug and Measures for Controlling It.....	30,000
763	Orchard Bark Beetles and Pinhole Borers and How to Control Them.....	30,000
764	Ginning Cotton.....	30,000
765	Breeds of Swine.....	65,000
766	The Common Cabbage Worm.....	45,000
767	Goose Raising.....	30,000
768	The Dwarf Broom Corns.....	60,000
769	Growing Grain on Southern Idaho Dry Farms.....	60,000
770	Canaries: Their Care and Management.....	60,000
771	Homemade Fireless Cookers and Their Use.....	100,000
772	Control of the Sugar-Beet Nematode.....	30,000
773	Corn Growing Under Droughty Conditions.....	55,000
774	Game Laws for 1916.....	90,000
775	Losses from Selling Cotton in the Seed.....	140,000
776	Growing Cherries East of the Rocky Mountains.....	30,000
777	Feeding and Management of Dairy Calves and Young Dairy Stock.....	100,000
779	How to Select a Sound Horse.....	80,000
780	Castration of Young Pigs.....	50,000
781	Tuberculosis of Hogs.....	50,000
782	The Use of a Diary for Farm Accounts.....	30,000
783	Laws Relating to Fur-Bearing Animals, 1916.....	30,000
784	Anthrax or Charbon.....	30,000
785	Seed-Flax Production.....	30,000
786	Fall-Sown Grains in Maryland and Virginia.....	30,000
787	Sea-Island Cotton.....	30,000
788	The Windbreak as a Farm Asset.....	30,000
789	Mushroom Insect Pests and How to Control Them.....	30,000
790	Contagious Abortion of Cattle.....	100,000
791	Turkey Raising.....	50,000
792	How the Federal Farm Loan Act Benefits the Farmer.....	150,000
793	Foxtail Millet: Its Culture and Utilization in the United States.....	30,000
794	Citrus Fruit Improvement: How to Secure and Use Tree Performance Records.....	50,000
795	The Domesticated Silver Fox.....	15,000
796	Some Common Edible and Poisonous Mushrooms.....	30,000
798	The Sheep Tick and Its Eradication by Dipping.....	20,000
799	Carbon Bisulphid as an Insecticide.....	20,000
800	Grains for the Dry Lands of Central Oregon.....	30,000
801	Mites and Lice on Poultry.....	20,000
803	Horse-Breeding Suggestions for Farmers.....	20,000
804	Aphids Injurious to Orchard Fruits, Currant, Gooseberry, and Grape.....	20,000
806	Standard Varieties of Chickens: I. The American Class.....	30,000
807	Bread and Bread Making.....	130,000
808	How to Select Foods: I. What the Body Needs.....	90,000
809	Marketing Live Stock in the South: Suggestions for Improvement.....	30,000
810	Equipment for Farm Sheep Raising.....	30,000
811	The Production of Baby Beef.....	30,000
812	How Live Stock is Handled in the Bluegrass Region of Kentucky.....	30,000
814	Bermuda Grass.....	30,000
816	Minor Articles of Farm Equipment.....	20,000
817	How to Select Foods: II. Cereal Foods.....	50,000
818	The Small Vegetable Garden.....	150,000
820	Sweet Clover: Utilization.....	30,000
821	Watermelon Diseases.....	20,000
822	Live-Stock Classifications at County Fairs.....	20,000

List of new Farmers' Bulletins issued during the year ended June 30, 1917, with the size of the first editions—Continued.

No. of bulletin.	Title.	Copies.
823	Sugar-Beet Sirup.....	30,000
827	Shallu, or Egyptian Wheat.....	30,000
835	How to Detect Outbreaks of Insects and Save the Grain Crops.....	20,000
838	Harvesting Hay with the Sweep-Rake: A Means by Which Eastern Hay-Growers May Save Labor.....	30,000
839	Home Canning by the One-Period Cold-Pack Method.....	300,000
841	Home and Community Drying of Fruits and Vegetables.....	250,000
852	Management of Common-Storage Houses for Apples in the Pacific Northwest.....	30,000
84	Total.....	4,515,000

Manuscripts for the first 14 new Farmers' Bulletins were sent to the Government Printing Office in the fiscal year 1916 but were not published until the year 1917, and requisitions for 22 reprints of Farmers' Bulletins sent to the Government Printing Office in the fiscal year 1916 were not executed until 1917.

During the fiscal year requisitions for 54 reprints of Farmers' Bulletins were not executed, and the work upon 9 new Farmers' Bulletins was not undertaken by the Government Printing Office.

The appropriation for Farmers' Bulletins was \$177,500, and 20,000 copies were allotted to each Senator, Representative, and Delegate in Congress. The congressional distribution during the year aggregated 8,811,150 copies and 6,621,110 copies were distributed by the department, largely in connection with its food-production work. The following statement shows the number of Farmers' Bulletins printed during the 28 years since the series was inaugurated, with the congressional distribution for each year:

Output of Farmers' Bulletins during 28 years, with congressional distribution.

Year.	New bulletins issued.	Total number of copies printed.	Copies distributed by Congressmen.	Year.	New bulletins issued.	Total number of copies printed.	Copies distributed by Congressmen.
1890-1893.....	14	540,000	.....	1907.....	42	6,469,000	3,484,713
1894.....	5	278,500	.....	1908.....	26	6,574,500	3,928,437
1895.....	11	1,567,000	885,770	1909.....	34	7,755,000	3,960,642
1896.....	13	1,891,000	1,316,695	1910.....	45	9,337,500	6,449,589
1897.....	16	2,387,000	1,967,237	1911.....	48	9,219,000	5,474,079
1898.....	21	2,170,000	1,580,065	1912.....	44	10,409,000	7,351,262
1899.....	22	2,437,000	1,101,985	1913.....	42	9,680,850	5,803,088
1900.....	18	2,360,000	1,666,909	1914.....	55	14,960,000	8,399,759
1901.....	14	3,345,000	2,195,010	1915.....	77	14,795,000	7,402,072
1902.....	23	6,150,000	4,289,126	1916.....	62	12,795,000	6,479,178
1903.....	22	6,602,000	3,954,976	1917.....	84	15,177,800	8,811,150
1904.....	25	6,435,000	4,895,556				
1905.....	24	5,925,500	4,782,643				
1906.....	33	6,568,000	5,279,476				
				Total.....	820	165,828,650	101,460,417

PUBLICATIONS RELATING TO FOOD PRODUCTION AND CONSERVATION.

During the last three months of the year an intensive campaign was conducted to increase the production of foods and to conserve the food supply of the country. The regular publications utilized in

this work by both the department and Senators, Representatives, and Delegates in Congress comprised the following, of which the editions printed were as indicated:

REGULAR PUBLICATIONS.

FARMERS' BULLETINS.

	Copies.
No. 34. Meats: Composition and Cooking.....	107, 100
121. Beans, Peas, and Other Legumes as Food.....	50, 200
203. Canned Fruits, Preserves, and Jellies.....	325, 000
249. Cereal Breakfast Foods.....	44, 400
255. Home Vegetable Garden.....	373, 325
256. Preparation of Vegetables for the Table.....	206, 150
293. Use of Fruits as Food.....	31, 975
295. Potatoes and Other Root Crops as Food.....	31, 660
298. Food Value of Corn and Corn Products.....	37, 900
363. Use of Milk as Food.....	52, 675
375. Care of Food in the Home.....	176, 375
391. Economical Use of Meat in the Home.....	237, 700
413. Care of Milk and Its Use in the Home.....	68, 300
487. Cheese: Economical Use in the Diet.....	101, 640
521. Canning Tomatoes: Home and Club Work.....	147, 275
535. Sugar and Its Value as Food.....	34, 375
565. Corn Meal as Food.....	130, 475
653. Honey and Its Use in the Home.....	50, 250
712. School Lunches.....	125, 675
717. Food for Young Children.....	353, 515
771. Homemade Fireless Cookers and Their Use in the Home.....	88, 050
807. Bread and Bread Making.....	130, 000
808. How to Select Foods: I. What the Body Needs.....	90, 000
817. How to Select Foods: II. Cereal Breakfast Foods.....	38, 441
818. The Small Vegetable Garden.....	1, 000, 000
839. Canning Vegetables and Fruits by the One-Period Cold-Pack Method.....	173, 315
841. Drying Fruits and Vegetables in the Home and Recipes for Cooking.....	149, 772
Total.....	4, 355, 543

EMERGENCY CIRCULARS AND POSTERS.

In addition to its regular bulletins, the department published five pamphlets under the title of "Food Thrift Series," dealing with the use of various foods and also other circulars relating to the necessity of increased production of crops and the conservation of food, as shown by the following statement:

CIRCULARS.

	Copies.
President's Appeal.....	505, 000
Program of Food Production and Conservation.....	60, 000
Backyard Poultry Leaflet.....	20, 000
Food Thrift Series No. 1.....	225, 000
Food Thrift Series No. 2.....	195, 000
Food Thrift Series No. 3.....	55, 000
Food Thrift Series No. 4.....	50, 000
Food Thrift Series No. 5.....	150, 000
Food Production Plan Submitted to the Senate.....	30, 000
Food Crops Must be Increased.....	180, 000
Conserve Foods: Begin Now.....	100, 000
Appeal to Women.....	50, 000
Total.....	1, 640, 000

POSTERS.

The department utilized many posters in its campaign for food production and conservation. Most of these were prepared jointly by the bureaus interested and the Office of Information. The number of copies distributed is shown below:

	Copies.
Farmers, Housewives, Children.....	300,000
Special Appeal to Farmer Patriots.....	254,500
Farm Help.....	210,000
Plant Corn.....	70,000
Cultivate Your Corn.....	150,000
How Much Turpentine Are You Wasting.....	2,500
More Rosin: Better Rosin.....	2,500
Help Feed Yourself.....	300,000
Waste No Food.....	100,000
Total.....	1,389,500

Both the special circulars and posters were distributed principally through the department's county agents, directors of extension work, and other agents and correspondents. Distribution was also made to official associations, war councils, civic organizations, and to patriotic clubs in all parts of the United States.

A grand total of 7,385,043 bulletins, emergency circulars, and posters was distributed in this campaign up to the close of the fiscal year.

PUBLICATION WORK OF THE WEATHER BUREAU.

In addition to the appropriation of not to exceed \$47,000 for printing contained in the general printing bill, the Weather Bureau had "\$14,000 for maintenance of a printing office in the city of Washington for the printing of weather maps, bulletins, circulars, forms, and other publications," and an appropriation for the pay of foremen, lithographers, pressmen, compositors, folders, and feeders for the printing of Weather Bureau publications that, in the judgment of the Secretary of Agriculture, can not be done at the Government Printing Office without impairing the service of the bureau. None of this work is under the supervision of this division, but under the direction of the chief of printing division of the Weather Bureau. This official, as usual, has kindly furnished the following summary of the publication work of the bureau for the year:

PERIODICAL PUBLICATIONS.

The daily, weekly, and monthly issues of periodical publications at the close of the fiscal year were as follows:

	Copies per issue.
Monthly Weather Review.....	1,475
Monthly Climatological Data for the United States.....	310
Washington Weather Map, 1st edition, daily except Sundays and holidays....	850
Washington Weather Map, 2d edition, daily except Sundays and holidays....	385
Washington Weather Map, Sundays and holidays.....	475
National Weather and Crop Bulletin (weekly from April to September, monthly from October to March).....	4,200
Snow and Ice Bulletin (weekly during the winter).....	1,210
Forecast cards (daily except Sundays and holidays).....	1,570
Weekly forecasts.....	875
Monthly Meteorological Summary for Washington, D. C.....	250

NEW PUBLICATIONS.

The following is a list of the principal nonperiodical publications issued during the year:

Daily River Stages at River Gage Stations on the Principal Rivers of the United States, for the Year 1915. Vol. XIII. 176 pages.

Weather Code, for the Transmission of Meteorological Observations. Revised edition, 1916. 100 pages.

Weather Forecasting in the United States. 370 pages, illus., charts.

Aerology No. 1. 67 pages, illus. Supplement No. 3, Monthly Weather Review.

Instructions for the Management and Care of Storm Warning Stations. 26 pages.

Weather Forecasting, with Introductory Note on Atmospheric. Bulletin No. 42, second edition. 37 pages.

Annual Report of the Chief of the Weather Bureau, 1915-1916. 282 pages, charts.

Description of Cloud Forms. Revised edition. 1 sheet, illus.

Types of Anticyclones of the United States and Their Average Movements. 25 pages, illus., charts. Supplement No. 4, Monthly Weather Review.

Aerology No. 2. 59 pages, illus. Supplement No. 5, Monthly Weather Review.

Weather Code for West Indian and Caribbean Sea Observers. 32 pages.

Relative Humidities and Vapor Pressures over the United States, including a Discussion of Data from Recording Hair Hygrometers. 61 pages, illus., charts. Supplement No. 6, Monthly Weather Review.

The Daily Weather Map, with explanation. 8 pages, 4 charts.

SALES OF DEPARTMENT PUBLICATIONS.

There is a steadily increasing willingness on the part of the public to purchase publications of the Superintendent of Documents, Government Printing Office, at the price affixed by him under the law. According to this official the sales of publications of this department for the year aggregated 364,100 copies, for which he received \$26,241.69. The sales of department bulletins for the last eight years and the amounts received are shown in the following table:

Department publications sold by the Superintendent of Documents.

Year.	Number of copies.	Amount received.	Year.	Number of copies.	Amount received.
1910.....	147,327	\$18,398.18	1914.....	231,821	\$21,708.76
1911.....	183,577	18,657.17	1915.....	335,863	23,011.10
1912.....	171,866	16,428.07	1916.....	327,381	22,277.84
1913.....	183,139	17,885.40	1917.....	364,100	26,241.69

The publications sent out by the Superintendent of Documents on paid subscription lists were as follows:

	Copies.
Journal of Agricultural Research.....	14,343
Experiment Station Record.....	8,428
Bureau of Animal Industry Service and Regulatory Announcements.....	350
Monthly Weather Review.....	1,363
Weekly News Letter.....	3,667
Total.....	28,151

Among the other publications for which there was considerable demand upon the Superintendent of Documents were:

Publication.	Number of copies sold.	Amount received.
Bul. 68, Bureau of Animal Industry, Information Concerning the Milch Goats....	1,627	\$244.05
Food charts, 1,085 sets.....	16,275	1,085.00
Forest Fires of the Pacific Slope.....	311	189.60
Dept. Bul. 57, Water Supply, Plumbing, and Sewage Disposal for Country Homes	2,340	234.00
Dept. Bul. 175, Mushrooms and Other Common Fungi.....	858	255.70
Dept. Bul. 354, Forests of Porto Rico.....	2,000	180.00
Dept. Bul. 319, Fermented Milks.....	1,201	60.05
Cir. 65, Office of Secretary, Regulations for Carrying out the Federal Aid Road Act.....	3,600	62.00

Notwithstanding the very wide free distribution of the Farmers' Bulletins by the department and by Senators, Representatives, and Delegates in Congress, the Superintendent of Documents sold 132,247 copies of them at 5 cents each.

Although at the head of all lists of publications issued by this department instructions are plainly printed advising applicants desiring to purchase publications to apply to and send remittances only to the Superintendent of Documents, Government Printing Office, many such requests accompanied by post-office money order, cash, or stamps are addressed to the department. A careful record of these is made in this office, and the letters and remittances are forwarded daily to the Superintendent of Documents. These remittances amounted to \$3,426.78 during the fiscal year ended June 30, 1917.

WORK OF THE DIVISION BY BRANCHES.

The four branches of the work of the division are under the immediate supervision of assistants in charge, as follows: (1) Editorial section, B. D. Stallings, editor and assistant chief; (2) indexing section, Charles H. Greathouse; (3) illustration section, A. B. Boettcher; (4) document section, Francis J. P. Cleary.

A brief statement of the operations of each branch follows:

EDITORIAL WORK.

The assistant in charge of manuscripts, of the Office of the Secretary, examined, criticized, and edited all manuscripts and approved them before they were forwarded for printing; but during the greater part of the year the more routine editorial work, the preparation of the manuscripts for the printer, and the reading of proofs, was done in the editorial section of the Division of Publications.

During the latter part of the fiscal year, however, all the strictly editorial work was taken over by the assistant in charge of manuscripts, of the Office of the Secretary, and three assistant editors have been detailed from this division to his office. Since that date no editorial work has been done in this division and its editorial section has been restricted to the supervision of the details inherent to the issuing of requisitions for printing, the transmitting of manuscript to the Public Printer, and the receiving and distributing of proof to and from the Government Printing Office and the editorial offices of the different bureaus.

The assistant in charge of manuscripts, of the Office of the Secretary, frequently called upon the committee on examination of manuscripts, which acts in an advisory capacity, for advice on matters of policy and classification.

The work of this section is shown by the tabulated statement of the bulletins, circulars, blanks, other job work, etc., issued during the year, all of which passed through the division. The manuscripts of all publications were handled under the direction of the editor and assistant chief in charge of the section, and during part of the year were prepared for printing by his assistant editors before being forwarded by him for printing.

The following statement shows the number of new publications and reprints issued during the year, and for comparison those issued during the last 10 years:

Class.	1908	1909	1910	1911	1912	1913	1914	1915	1916	1917
New publications....	447	650	1,085	1,170	1,250	1,771	1,152	913	944	1,132
Reprints.....	998	485	462	696	648	429	474	393	357	390
Total.....	1,445	1,135	1,547	1,866	1,898	2,200	1,626	1,306	1,301	1,522

The miscellaneous printing, such as blanks, circulars of inquiry, blank books, and job work generally, was handled as usual in this section.

The new publications issued comprised 32,049 printed pages, and there were 5,033 illustrations.

INDEXING SECTION.

The introduction of a method of handling the index cards by which indexes of bound volumes will be made by assembling cards already on hand was the principal advance made in this section during the year. This will make it possible, it is hoped, to assemble promptly the indexes for the bound volumes of Farmers' and department bulletins.

The routine of the work, depending largely upon what has been done by the scientific and other bureaus in the way of publications, this year has been much the same as for the three or four years preceding.

Indexing hearings and parts of the Congressional Record in which the Secretary and others in the department are interested has occupied a considerable part of the time of the indexers.

There has not been a satisfactory increase in the demand for the information from the card indexes during the year, though recognition of their value has continued especially from those in the department who have previously found how to get information from them. Also there has been some increase in their use by the public.

It is desirable to make the existence of the indexes so well known that anyone who wishes to know what has been published by the department on any subject will turn at once to them and secure the desired information. Many new employees have entered the department since the establishment of this service and hundreds do not know of the existence of this key to the department publications.

The number of cards written this year was 60,774, against 60,290 last year; the number of pages indexed was 28,176, against 24,201 last year. This is an increase made possible by added experience

and the use of improved methods. The totals given do not take into account some thousands of pages of the Congressional Record indexed nor of some 3,000 cards written for Yearbook illustrations.

There is urgent need, as at the close of last year, for binding the department publications for permanent preservation in a fireproof room; also the indexing of the second 500 Farmers' Bulletins, bringing it up to an index for the first 1,000, together with an index of the next period of Yearbooks, 1911-1915. It will not be possible to bring the indexing to the required point without the help of more indexers.

Better protection should be given to the sets of books maintained by this section.

ILLUSTRATIONS SECTION.

During the year 1,840 drawings were prepared by the draftsmen. The majority of these drawings were of a nature requiring special skill and an exceptional amount of time and care.

Photographic work done for the different bureaus, divisions, and offices of the department and for the public during the fiscal year 1917.

Bureau, division, or office.	Photostat prints.	Contact prints.	Negatives.	Developing.	Lantern slides.	Lantern slides colored.	Bromide enlargements.	Bromide enlargements colored.	Solar bromides.	Maps and prints mounted.	Transparencies made and colored.	Total.
Office of the Secretary.....	4,291	5,166	566	82	188	.....	231	.....	30	506	.....	11,062
Weather Bureau.....	.....	796	179	12	168	.....	27	.....	3	.....	.....	1,185
Bureau of Plant Industry.....	5,605	32,563	1,783	2,787	3,584	235	305	5	496	873	.....	48,236
Bureau of Animal Industry.....	11	11,929	1,721	688	2,685	130	1,015	47	137	1,353	4	19,720
Bureau of Chemistry.....	208	3,445	457	74	141	4	28	.....	62	35	.....	4,454
Bureau of Biological Survey.....	14	11	1	.....	.....	.....	.....	.....	3	.....	.....	29
Bureau of Crop Estimates.....	3,104	604	102	.....	.....	.....	14	.....	108	57	.....	3,984
Bureau of Entomology.....	803	1,342	101	150	524	.....	1	.....	35	3	.....	2,959
States Relations Service.....	415	8,044	1,013	456	13,060	2,084	66	.....	125	238	.....	25,501
Division of Publications.....	25	3,220	78	.....	11	.....	5	.....	94	3,337	.....	6,770
Office of Public Roads and Rural Engineering.....	8	4	7	.....	.....	.....	45	.....	483	.....	.....	547
Office of Markets and Rural Organization.....	11	2	.....	.....	86	.....	.....	.....	15	3	.....	117
Library.....	566	2	2	.....	.....	.....	.....	.....	.....	.....	.....	570
Paid orders.....	.....	1,785	11	.....	920	2	8	1	37	9	.....	2,773
Total.....	15,061	68,913	6,021	4,249	21,367	2,455	1,745	53	1,623	6,416	4	127,907

In the photographic laboratory a total of 127,907 pieces were prepared, compared with 118,441 pieces during the preceding year.

A gratifying feature of the work is the growing tendency of the scientists of the various bureaus and offices to avail themselves of the facilities of this laboratory for producing the original negatives used in their researches. This item shows a large increase over previous years. A complete outfit for photomicrographic work has been added to the equipment and is being extensively used.

One hundred and seventy requests for photographic work were received from persons outside the department, for which a total of \$598.74 was collected and turned over to the disbursing office. In addition a large number of cuts used in illustrating the department's publications were taken from the files and sent to electrotypers, who furnished duplicates to the applicants at their expense, these cuts being afterwards returned to the files.

Summary of drawings prepared during the fiscal year 1917.

Office of the Secretary	393
Weather Bureau	21
Bureau of Plant Industry	308
Bureau of Animal Industry	531
Forest Service	11
Bureau of Chemistry	71
Bureau of Biological Survey	75
Bureau of Crop Estimates	125
Bureau of Entomology	35
States Relations Service	204
Division of Publications	15
Office of Public Roads and Rural Engineering	16
Office of Markets and Rural Organization	34
Federal Horticultural Board	1
Total	1,840

THE MOTION-PICTURE LABORATORY.

This work, which is under the direction of the committee on motion-picture activities, produced a total of 17,730 feet of negative film and 62,530 feet of positive film. It also developed 4,360 feet of negative film made elsewhere.

Of the above film, 2,800 feet of negative and 3,250 feet of positive were used in producing and assembling subjects for other departments of the Government service, the expense being defrayed by the department interested.

Five new films comprising 18 reels were completed for the various bureaus and offices of the department. These films were used extensively in connection with field and demonstration meetings and were shown at country schoolhouses, churches, and county fairs by the department's representatives.

DOCUMENT SECTION.

DISTRIBUTION OF PUBLICATIONS.

On July 1, 1916, there were 7,561,293 publications in the hands of the Superintendent of Documents and available for distribution by the department. During the fiscal year just ended 41,991,331 copies of publications were printed, making the total number of copies available for distribution 49,272,624. In addition to these publications there were 6,100,000 lists of Farmers' Bulletins, making the total distribution 55,572,624. Of the entire number available for distribution 47,912,886 copies were distributed, leaving a balance of 7,739,738 copies on hand at the close of business June 30, 1917.

This distribution, which exceeds in its grand total that of any previous year, is divided, mainly, into two classes, namely, Farmers' Bulletins and miscellaneous publications. Of the miscellaneous publications available for distribution, aggregating 29,130,086, there were 14,047,426 distributed by Superintendent of Documents and 12,333,200 by the folding room of this office, leaving a balance on hand June 30, 1917, of 2,632,460.

There were 15,432,260 Farmers' Bulletins distributed by the Superintendent of Documents during the fiscal year, leaving a balance on hand June 30, 1917, of 5,107,278. Of the total number of that series of bulletins distributed, 6,621,110 copies were distributed upon

requests of miscellaneous applicants, orders from the bureaus, offices, and divisions of the department, to newspapers, and to other outside agencies cooperating with the department; 2,896,241 copies of these were sent upon requests of newspapers and other agencies, which leaves a total of 3,603,585 copies distributed to actual miscellaneous applicants.

The policy in handling miscellaneous requests, namely, of sending about one-tenth of the number requested, where the applicant requests more than one copy, and informing him that additional copies may be secured by applying to some Senator or Representative in Congress, or that they may be secured by purchase from the Superintendent of Documents, Government Printing Office, has been maintained.

The work of distributing the enormous number of publications above mentioned involves a great deal of clerical as well as manual labor, although most of the latter is performed in the Office of the Superintendent of Documents, Government Printing Office. Thousands of individual publications are carried in stock, and correct records of this stock must be kept in order to furnish proper information and regulate the distribution. In connection with this work there are multitudinous details, a knowledge of which can be acquired only by long experience in the work of this office and the general activities of the department.

CONGRESSIONAL DISTRIBUTION.

In connection with the work of supplying the publications requested by Members of Congress 51,409 orders were issued on the Office of the Superintendent of Documents, Government Printing Office. These orders were for miscellaneous publications, or publications other than Farmers' Bulletins. It is estimated that these requests would average five publications and would aggregate approximately 257,045 miscellaneous publications furnished at the request of Members of Congress.

In the work of the congressional distribution of Farmers' Bulletins there were received 57,553 letters requesting that Farmers' Bulletins be sent to addresses either furnished on addressed franks by Members of Congress or indicated in their letters.

In executing requests contained in this correspondence it was necessary to issue 49,751 orders on the Office of the Superintendent of Documents, Government Printing Office for the distribution of 8,811,150 copies, an increase of more than 35 per cent over the previous year.

Involved in the congressional distribution was the sorting and counting of millions of franks, checking and counting the aggregate number of Farmers' Bulletins indicated on checked lists of Farmers' Bulletins, substituting bulletins pertaining to the same subjects for those the supply of which was exhausted, and in many cases making a selection of bulletins to be sent at the request of a Senator or Representative.

This work is exceedingly heavy at times and taxes greatly the capacity of the small force of persons engaged in handling it; and there is a rush season, when it is very advisable in order to give proper and efficient service that additional employees be assigned to the work for two or three months.

MAILING LISTS.

At present there are 275 mailing lists maintained by the department. The greater number, 259 lists, aggregating 461,304 addresses, are at the Office of the Superintendent of Documents, Government Printing Office. Sixteen lists, aggregating 206,132 addresses, are kept in this section.

All lists are merged in the general index kept in this office. This index has proved to be of inestimable value when making changes in the various mailing lists; it avoids duplication and reduces to a minimum the amount of time consumed in handling such work.

The following statement shows in detail the work done in the mailing lists records unit of this section:

Addresses:

List of, written for different divisions and from lists furnished by miscellaneous correspondents.....	426, 915
Supervising mailing lists at the Government Printing Office, comprising approximately.....	500, 000
Issuing directions for adding.....	205, 575
Dropping and changing.....	40, 000
Adding to the Monthly List of Publications.....	65, 000
Revising, on the Crop Report list.....	5, 000
Comparing.....	250, 000
Indexing.....	300, 000
Typewriting cards for general index.....	300, 000
Separating lists of Farmers' Bulletins.....	157, 000
Counting lists of Farmers' Bulletins.....	157, 000
Assembled press-notice sheets.....	546, 949
Assembled and collated Notice of Judgment Supplements 11 to 20, inclusive, Nos. 4001 to 4500.....	225
Folding, filling, and mailing parcels of mail matter.....	546, 947

WORK OF MACHINE ROOM.

Incident to the work of distributing the publications is the issuing of many form letters, press notices, printing of return envelopes, cutting of paper and franks, cutting stencils, folding circulars, schedules, etc.

The output of the machine room has grown rapidly.

During the year 1917 there were produced on either multigraph or mimeograph machines, 2,419 jobs (1,462 were on the multigraph and 957 on the mimeograph). The number of pages included in these jobs was 6,016,276, of which 3,686,871 copies were ordered. Included in this work was the assembling of 656,893 pages of matter and the stapling of 147,232.

While the total number of jobs handled is 56 less than the year previous, the number of copies was 618,833 more than during the previous year, being an increase of more than 20 per cent. This increase in output was accomplished despite the fact that the efficiency of the machine room unit was reduced appreciably by the temporary loss of 19 skilled operators.

The duplicating work is only one phase of the activities of this section. In making additions, drops, and changes on the various mailing lists maintained in this office 59,077 stencils were cut; 30,065 stencils were removed from the files; envelopes and franks numbering 5,420,248 were addressed on addressing machines; franks furnished by Members of Congress numbering 746,362 and 863,723 sheets of

paper furnished by various bureaus of the department were cut; loose sheets of waste paper were made into 24,665 pads and distributed throughout the department; 2,950,200 circulars were folded on the folding machine.

Owing to the increased activities of the various bureaus of the department, incident to gathering and distributing information to stimulate production and conservation of food, the work of addressing envelopes and franks has greatly increased. It has been only by exceptionally hard work and by working many extra hours that it has been possible to keep the work up sufficiently well to execute the most important of the orders. Additional help and equipment will be needed to do the work required of this office if it continues to increase as it has increased during the last three months of this year.

Not only has this office done work for practically every bureau, division, and office in the department, but it rendered considerable assistance to the Publicity Bureau of the Liberty Loan Division of the Treasury Department, and to the Committee of Public Information by addressing each week envelopes to be used by them, from the mailing lists maintained in this office.

Following is a summary of the work done in the machine room for the various bureaus, divisions, and offices of the department:

Summary of multigraph and mimeograph work.

Bureau, division, or office.	Number of jobs.		Number of pages.	Number of copies.
	Multi-graph.	Mimeograph.		
Office of the Secretary.....	161	28	450,715	359,689
Office of the chief clerk.....	23	2	29,020	20,060
Office of the solicitor.....	64	-----	68,730	67,930
States Relations Service.....	339	-----	318,000	202,000
Office of Information.....	7	836	3,500,051	1,626,431
Bureau of Plant Industry.....	197	-----	588,095	524,525
Division of Publications.....	68	74	371,025	357,925
Office of Public Roads.....	4	-----	6,300	1,800
Federal Horticultural Board.....	105	-----	145,900	114,950
Bureau of Chemistry.....	267	2	205,665	141,466
Bureau of Biological Survey.....	76	1	104,700	98,750
Office of appointment clerk.....	13	-----	21,000	20,750
Bureau of Entomology.....	61	-----	141,475	90,350
Insecticide and Fungicide Board.....	20	10	11,160	11,090
Bureau of Crop Estimates.....	3	-----	1,825	1,825
Bureau of Animal Industry.....	25	1	38,200	38,100
Division of Accounts.....	13	3	6,565	2,330
Office of Markets and Rural Organization.....	2	-----	1,000	1,000
Bureau of Soils.....	2	-----	150	150
Forest Service.....	4	-----	1,500	1,500
Library.....	8	-----	5,200	4,250
Total.....	1,462	957	6,016,276	3,686,871

Total number pages assembled..... 656,892
 Total number pages stapled..... 147,232

WORK OF THE FOLDING ROOM.

The work of the folding room of this section has been increased by reason of the large number of emergency circulars and leaflets mailed direct from the department, as will be seen from the figures given below.

The increase in the number of pamphlets, publications, and leaflets mailed from the folding room over the year previous is approximately

2,000,000. The increase in this line of work is represented largely by the great number of emergency leaflets, many of which were prepared in the Office of Information and distributed by this division. This work has been of a rush character, corresponding with that of the machine room, and the employees have been forced to work extra hard to get it out. In fact, there is not sufficient force to do this, and there have been times when certain classes of the work were several weeks in arrears, due to the fact that the activities of the force were centered upon emergency work.

SUMMARY OF THE WORK OF THE FOLDING ROOM.

(A) Sent out:		Copies.
Monthly List.....		118, 000
Weekly News Letter.....		1, 902, 000
Crop Report.....		144, 000
Press Notices.....		1, 626, 431
Farmers' Bulletin Lists, general.....		5, 100, 000
Farmers' Bulletin Lists, city.....		1, 000, 000
Publications as per scheme.....		1, 909, 756
Publications to transients and sundry requirements.....		75, 000
Monthly List of Station Publications.....		15, 600
Crop Synopses.....		63, 200
Flexotype forms of instructions, etc.....		380, 000
Posters.....		1, 357, 200
Food Thrift series.....		585, 500
Chemistry cards.....		186, 327
Appeals and emergency leaflets.....		2, 036, 500
Total.....		16, 499, 514
(B) Folded:		
Press Notices.....		1, 626, 431
Miscellaneous (department circulars, etc).....		340, 000
Flexotype forms of instructions.....		380, 000
Crop synopses.....		63, 200
Monthly List of Station Publications.....		15, 600
Posters.....		1, 357, 200
Food Thrift series.....		585, 500
Appeals and emergency leaflets.....		1, 978, 000
Total.....		6, 345, 931
(C) Separated:		
Farmers' Bulletin Lists, general.....		2, 500, 000
(D) Wrapped:		
Yearbooks.....		2, 000
Field Operations, Bureau of Soils—		
Maps.....		300
Texts.....		300
Annual Reports, Department of Agriculture.....		100
Miscellaneous returned bound volumes.....		750
Posters.....		675, 000
Total.....		678, 450

(E) Stuffed and sealed:	Copies.
Monthly List.....	88,500
Weekly News Letter.....	1,426,500
Crop Report.....	108,000
Press Notices.....	1,219,823
Publications as per scheme.....	954,878
Monthly Lists of Station Publications.....	15,600
Crop synopses.....	63,200
Flexotype forms.....	380,000
Posters.....	682,200
Food Thrift series.....	292,750
Chemistry cards.....	186,327
Total.....	5,417,778
Grand total.....	32,445,121

FOREIGN MAIL.

Fifteen bureaus or offices of the department ordered publications mailed to foreign addresses. These orders called for 73,201 packages of publications, weighing 26,537 pounds 4 ounces, requiring postage costing \$2,108.52.

In addition to this class of mail there were 6,205 packages, weighing 3,166 pounds 8 ounces, sent through the Smithsonian Exchange, at a cost of \$158.33.

The total number of packages sent abroad was 79,406, weighing 29,523 pounds 12 ounces, the cost in postage and exchange fees being \$2,266.91, which sum was only \$28.57 less than the sum expended for like purposes during the last fiscal year, despite the fact that the sending of publications to Germany and the countries allied with it was discontinued.

A summary of the record of foreign-mail distribution is given below:

Summary of the foreign mail for the fiscal year ended June 30, 1917.

Bureau, division, or office,	Packages requiring postage.				
	Number.	Weight.		Postage.	
		Pounds.	Ounces.	Dollars.	Cents.
Bureau of Animal Industry.....	3,861	644	8	51	56
Bureau of Biological Survey.....	606	76	14	6	15
Bureau of Chemistry.....	3,178	694	14	55	59
Bureau of Crop Estimates.....	1,625	231	6	18	51
Bureau of Entomology.....	5,336	1,116	10	89	33
Forest Service.....	368	62	.....	4	96
Journal of Agricultural Research.....	16,540	7,395	8	591	64
Library.....	18,864	6,034	.....	482	72
Office of Markets and Rural Organization.....	1,789	314	14	25	19
Bureau of Plant Industry.....	4,472	1,601	.....	128	8
Division of Publications.....	8	6	.....	.....	48
Office of Roads and Rural Engineering.....	961	181	.....	14	48
Office of Secretary.....	1,033	230	6	18	43
Bureau of Soils.....	160	21	12	1	74
States Relations Service.....	14,400	7,746	8	619	72
Total for fiscal year 1917.....	73,201	26,357	4	2,108	58
Total for fiscal year 1916.....	76,645	26,235	6	2,098	83
Decrease during fiscal year 1917.....	3,444	(1)	(1)	(1)	(1)

¹ Increase in weight of packages to which postage was affixed: 121 pounds 14 ounces, \$9.75.

Summary of the foreign mail for the fiscal year ended June 30, 1917—Continued.

Bureau, division, or office.	Packages sent through the International Exchanges.				Total.				
	Num-ber.	Pounds.	Value.		Num-ber.	Pounds.	Ounces.	Dol-lars.	Cents.
			Dol-lars.	Cents.					
Bureau of Animal Industry.....	975	345	17	25	4,836	985	8	68	81
Bureau of Biological Survey.....	8	5	.....	25	614	81	14	6	40
Bureau of Chemistry.....	306	121	6	5	3,484	815	14	61	64
Bureau of Crop Estimates.....	155	56	2	80	1,780	287	6	21	31
Bureau of Entomology.....	558	190½	9	53	5,894	1,307	2	98	86
Forest Service.....	59	27	1	35	427	89	.....	6	31
Journal of Agricultural Research.	41	49	2	45	16,581	7,444	8	594	9
Library.....	2,294	1,698	84	90	21,158	7,732	.....	567	62
Office of Markets and Rural Or- ganization.....	337	73	3	65	2,126	387	14	28	84
Bureau of Plant Industry.....	827	289	14	45	5,299	1,890	.....	142	53
Bureau of Publications.....	7	5	.....	25	15	11	.....	.....	73
Office of Roads and Rural En- gineering.....	547	177	8	85	1,508	358	.....	23	33
Office of Secretary.....	24	100	5	.....	1,057	330	6	23	43
Bureau of Soils.....	14	8½	.....	43	174	30	4	2	17
States Relations Service.....	53	22½	1	12	14,452	7,769	.....	620	84
Total for fiscal year 1917...	6,205	3,166½	158	33	79,406	29,523	12	2,266	91
Total for fiscal year 1916.....	7,328	2,933	196	65	83,973	30,168	6	2,295	43
Decrease during fiscal year 1917.....	1,123	766½	38	32	4,567	644	10	28	57

TOTAL PACKAGES SENT ABROAD DURING FISCAL YEAR 1917.

Item.	Number.	Pounds.	Ounces.	Dollars.	Cents.
Packages to which postage was affixed.....	73,201	26,357	4	2,108	58
Packages sent through the International Exchange, Smithsonian Institution.....	6,205	3,166	8	(1)	(1)
Grand total.....	79,406	29,523	12	2,266	91

¹The Smithsonian Institution is reimbursed from the department's contingent fund at the rate of 5 cents per pound.

REPORT OF THE CHIEF OF THE BUREAU OF CROP ESTIMATES.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF CROP ESTIMATES,
Washington, D. C., September 19, 1917.

SIR: I have the honor to submit herewith the report of the Bureau of Crop Estimates for the fiscal year ended June 30, 1917.

Respectfully,

LEON M. ESTABROOK,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

PERSONNEL.

During the fiscal year ended June 30, 1917, the total number of permanent salaried employees in the Bureau of Crop Estimates was 165, of whom 112 were stationed in Washington, D. C., and 53 stationed in the field. In addition to the regular force in the Washington office it was found necessary to employ from 7 to 14 temporary clerks and skilled laborers for all or a portion of the year in order to handle the greatly increased volume of work, the number of schedules mailed and sorted having increased from 1,405,274 for the fiscal year 1916 to 2,056,420 for the fiscal year 1917, or an increase of 46.3 per cent. Correspondence and other clerical work increased in about the same proportion.

The total number of voluntary crop reporters and special correspondents who served without compensation was approximately as follows:

Township.....	31, 338	Potato	4, 067
County.....	2, 793	Peanut	4, 351
County aids (estimated).....	5, 586	Comparative price.....	796
Field aids.....	15, 843	Broom corn.....	1, 040
Special price.....	6, 051	Live stock.....	10, 860
Apple	8, 238	Mills and elevators.....	13, 351
Cotton crop specialist.....	857	Individual farm.....	33, 548
Individual farm, cotton.....	8, 653	Maple sirup.....	1, 716
Special cotton.....	5, 464	Truck crop specialist.....	8, 746
Sheep	6, 445		
Bee	8, 995	Total.....	174, 103
Cranberry	365		

ADMINISTRATIVE OFFICE.

The administrative office of the bureau, under the direct supervision of the chief of bureau, the assistant chief of bureau, and the chief clerk, effected various improvements in methods of filing bureau records, keeping account of bureau finances and property, and in supervising and facilitating the work of the office and field force, as well as directing activities of the bureau and looking after the increased volume of correspondence.

The records show a large increase in the amount of work performed in the office of the chief clerk and by the bureau as a whole. In the multigraph section there was an increase of 22.6 per cent in the number of jobs handled on the multigraph and mimeograph machines, 20.8 per cent in the number of copies run, 113 per cent in the number of copies folded, and 108 per cent in the number of lines printed, over the fiscal year 1916. For the truck crop section alone there was an increase of 36 per cent in the number of copies printed and folded during 1917 over 1916. The increase in the duplicating work is significant when it is remembered that several of the field agents have been supplied with mimeograph machines and now do their own form-letter work.

The increase in the activities of the bureau is reflected especially in the number of envelopes used, the increase in 1917 over 1916 being approximately 65 per cent.

Additional field men have been employed, and those already in the service have enlarged the scope of their investigations, all of which has greatly augmented the work of the accounting, supply, and multigraph sections. The work in the supply section has increased to such an extent that the appointment of an additional laborer is recommended. In the accounting section the number of clerks is one less than it was three years ago.

During the fiscal year just closed preliminary steps were taken largely to increase the mechanical equipment of the bureau. When completed the bureau will be in a much better position to cope with the rapidly increasing volume of mail entailed by the widening scope of the bureau's investigations.

Because of growth in force, equipment, and volume of business, the bureau is badly handicapped by lack of sufficient space.

DIVISION OF CROP REPORTS.

The work of the Division of Crop Reports, under the direct supervision of Mr. Edward Crane, chief of division, increased nearly 50 per cent during the fiscal year 1917, the total number of schedules and circulars handled by the division exceeding 2,000,000. This increase was largely due to the rapid growth of the truck crop investigations and to numerous special inquiries relating to minor crops and to particular phases of staple-crop and live-stock production. The work of this division consists mainly in the preparation of crop schedules several months in advance of their use, the mailing out of schedules to the field agents and voluntary crop reporters, the opening, sorting, and classifying of the returned schedules, the editing, checking, tabulating, adding, and averaging of the returns, and the maintenance of lists of crop and special voluntary reporters. The data collected and compiled by this division, supple-

mented by reports from the field service, form the basis of the monthly and special crop reports of the bureau.

Eighty-eight maps and charts were prepared in this division for use in the Monthly Crop Report and for other purposes.

DIVISION OF CROP RECORDS.

This division, under the direct supervision of Mr. Frank Andrews, chief of division, has charge of the official records of crop estimates concerning the United States from Federal, State, and private sources, and agricultural statistics of foreign countries. The records have been compiled from published and unpublished reports in such a way as to show in concise and convenient form information that is given in the original reports in a more or less scattered way, usually in a long series of reports and frequently in foreign units of weight and measure. In every completed office record these units of foreign weight and measure have been converted to the equivalent American units. Statistical records relating to agriculture have been completed for 13 principal foreign countries, and show acreage and production of crops, numbers of different classes of live stock, etc., from the earliest to the latest years for which figures are available. In addition to the regular compilation of records the foreign crop work has included a large amount of special compilations and correspondence. When the compilation of agricultural statistics for the remaining countries is finished—probably within the next year or two—the Bureau of Crop Estimates will have one of the most complete records of estimates and statistics relating to world crops and live stock in existence, all expressed in terms of American units and in such convenient form as to be immediately available for reference. Estimates of United States crop production, as made by State officials and private parties, have been segregated and entered on record practically as soon as received in the division.

The special investigations of this division included a comprehensive inquiry as to production compared with supply of principal farm products; also an inquiry as to geographic variations in prices paid to farmers. Manuscript reports on parts of these two investigations were submitted for publication within the fiscal year.

Reports on the sugar crops of the United States and Hawaii are compiled in this division. These reports are based upon actual enumerations, and in this respect are an exception to the general crop-reporting system of the bureau. During the year three reports were made relating to beets and beet sugar; namely, acreage planted, preliminary estimate of beets produced and sugar made, and after the close of the season a final estimate of beet and sugar production. There was also made, in December, the first estimate of this bureau on the acreage and production of sugar-beet seed. Three reports were made on the Louisiana sugar industry; one in December, giving the estimated tonnage of cane to be used for sugar; one in January, giving a preliminary estimate of the sugar made; and a final report in May, giving the annual production of sugar, as well as the tonnage and acreage of cane used. One report was made for the Hawaiian industry, giving the final figures for acreage and production of cane and the production of cane sugar. The second annual report on maple sugar was planned and completed in this division.

As supplementary to the bureau's estimates of durum wheat production the Division of Crop Records made its eleventh annual estimate of the total exports of durum wheat from the United States, which was based upon reports received from various commercial agencies.

A large number of special compilations were made for the Secretary, the Assistant Secretary, other branches of the department, Senators and Representatives in Congress, and other persons interested in agricultural statistics. Food production and supply in the United States and foreign countries was a frequent subject of inquiry.

In order to furnish data as promptly as possible, a series of office tables, with duplicate copies, is maintained. The tables number over 400 and cover subjects for which there is likely to be a demand, and which relate to crop estimates.

FIELD SERVICE.

The field service, composed of salaried field agents and crop specialists under the supervision of Mr. S. A. Jones, made excellent progress during the past year. The present force consists of 41 State field agents and 10 crop specialists. Each field agent has charge of a State or group of small States, and in both Texas and California two field agents are stationed, each being responsible for the reports on certain crops. The crop specialists disregard State lines, but where two or more are engaged in reporting on the same crop the territory is divided.

TRUCK CROP ESTIMATES.

The truck-crop estimating service, which was organized in 1915, increased the scope of its inquiries considerably in the past fiscal year. Three assistant truck-crop specialists were appointed and assigned permanently to the Atlantic Coast States, the Gulf Coast States, and the Pacific Coast States. The work of this section shows an increase of more than 60 per cent during the year, and the number of reports on truck crops more than doubled. Since July 1, 1916, estimates of acreages of various truck crops and car-lot shipments have been compiled by shipping points, and much other valuable information for future use has been collected.

Owing to the extremely perishable nature of truck crops it is realized that the present method of reporting on them monthly is inadequate as a guide to enable growers to determine the acreages which may safely be planted in different regions or to meet the needs of growers and commercial handlers in marketing and distributing the crop. It is therefore planned to inaugurate a system of weekly truck-crop reports during the coming season.

FRUIT CROP ESTIMATES.

In order to determine more accurately the fruit production of the United States a fruit-crop estimating service was organized in the latter half of the fiscal year 1917. Three assistant fruit-crop specialists were appointed and were directed to travel in the principal producing regions (1) to make a statistical survey as a basis for future estimates, (2) to organize a corps of voluntary fruit-crop re-

porters, and (3) to establish in working order an efficient system of fruit-crop estimates. The office work in Washington was placed in charge of an experienced statistical clerk, and further clerical help was given from time to time by other branches of the bureau.

At the end of the fiscal year (June 30, 1917), two crop reports had been made, and the county surveys had covered about 100 counties.

The fruit-crop work of the 1917 season is to be confined to apples, and as soon as the apple estimating is well organized other fruits will be included. The crop included in this work had an average farm value in 1910-1914 of over \$200,000,000, and in 1916 the farm value of three of these crops (apples, peaches, and pears) exceeded \$237,000,000.

MONTHLY CROP REPORTS.

During the year the bureau issued estimates of the numbers, prices, and value of different classes of live stock, losses from disease and exposure, number of breeding sows, and the number of stock hogs compared with last year.

Acreage estimates were made in June for barley, oats, spring wheat, alfalfa hay, clover hay, and sugar cane; in July for corn, rice, timothy hay, potatoes, sweet potatoes, cotton, flaxseed, sorghum, and tobacco; in August for buckwheat, hay (tame hay, wild hay, and total); in September for clover seed; and in December for rye and winter wheat. Acreage remaining after abandonment was estimated for winter wheat and rye in May and for cotton in December.

Monthly during the crop season estimates were made of the condition of the growing crops as a percentage of normal for cereals, including barley, buckwheat, corn, oats, rice, rye, wheat (spring and winter), forage, including alfalfa hay, alfalfa for seed, bluegrass for seed, field peas, clover for hay, clover for seed, hay (tame hay, wild hay, and total), kafirs, meadows, millet, pasture, and timothy; fruits, including apples, apricots, blackberries, and raspberries, cantaloupes, cherries, cranberries, figs, grapefruit, grapes, lemons, limes, olives, oranges, peaches, pears, pineapples, plums, prunes, and watermelons; vegetables, including lima beans, cabbage, cauliflower, celery, onions, potatoes, sweet potatoes, and tomatoes; miscellaneous, including almonds, broom corn, cotton, flaxseed, hemp, hops, peanuts, percentage of planting done, percentage of plowing done, sorghum cane, sugar beets, sugar cane, tobacco, English walnuts, and wool.

Yield per acre was estimated in August for clover hay; in September for alfalfa and timothy hay; in October for alfalfa seed, cabbage, onions, broom corn, hemp, and hops; in November for clover seed, kafirs, cranberries, peanuts, and sorghum sirup; and in December for all principal crops for which acreage estimates were made. During the growing season the condition reports, expressed as a percentage of normal for all crops for which acreage is estimated, were interpreted in yield per acre as a forecast of production.

The percentage of a full crop produced was estimated in April for celery in California; in May for cauliflower in California; in August for clover hay, apricots (California), blackberries and raspberries, cherries (California), pineapples (Florida); in September for alfalfa hay, bluegrass seed, timothy hay, cantaloupes, peaches, plums (Cal-

fornia), and watermelons; in October for alfalfa seed, millet, prunes (California), field beans, lima beans, cabbage, onions, tomatoes, broom corn, hemp, and wool; in November for clover seed, field peas, kafirs, apples, cranberries, figs, grapes, pears, almonds (California), peanuts, and English walnuts (California).

Farm prices of all crops and live stock were estimated monthly.

Final estimates of acreage, yield, and total production were made in December for barley, buckwheat, corn, oats, rice, rye, wheat, hay, potatoes, sweet potatoes, flaxseed, cotton, tobacco, broom corn, hemp, kafirs, beans, hops, and cranberries.

The percentage of the corn crop cut for silage was estimated in November.

The percentage of the crop of merchantable quality was estimated in March for corn.

The percentage of crops shipped out of counties where grown was estimated in March for barley, corn, oats, and wheat.

The quality of crops produced was estimated in August for rye, winter wheat, and clover hay; in September for tame and wild hay and peaches; in October for barley, oats, spring wheat, and hops; in November for buckwheat, corn, apples, cranberries, grapes, pears, potatoes, sweet potatoes, flaxseed, peanuts, and tobacco; in December for grapefruit (Florida), lemons (California), limes (Florida), and oranges.

Supplies on farms were estimated in March for barley, corn, oats, and wheat; in May for hay; in July for wheat; in August for barley and oats; and in November for corn.

The weight for fleece was estimated in July for wool and per bushel for barley, oats, winter wheat, and spring wheat in November.

SPECIAL REPORTS.

In addition to the monthly crop reports, the following reports were prepared for issuance to the press or for publication in the Monthly Crop Report:

Corn:

- Per cent of yellow, white, and mixed, 1915-16.
- Portion merchantable, 1883-1916.

Wheat:

- Durum, receipts and exports.
- Exports, 1910-1916.
- Farm marketings, monthly.
- Farm movement and prices.
- Held in mills and elevators, 1913-1917.
- Monthly marketing by farmers.
- Spring, cause of shortage.
- Spring, production in 1916 of different varieties in three States.
- Supply and distribution per capita.
- Surplus and deficiency.
- World and United States production and exports, 1906-1915.
- World production, 1913-1916.

Oats:

- Winter oats in Southern States.

Cotton:

- Crop value, 1915.
- Length of lint, crops of 1915 and 1916.

Tobacco:

- Held by manufacturers and dealers.
- Report by types and districts.

Rice:

Accuracy of department's estimate, 1915.
 Varieties sown, 1916.

Truck crops:

Acreage in corn, peas, and tomatoes contracted for by canneries.
 Bean crop forecast.
 Cabbage, commercial crop forecast.
 Celery acreage.
 Cranberry crop, 1914-1916.
 Cucumbers, acreage contracted to pickling factories.
 Kraut report.
 Melons, commercial acreage.
 Onions, commercial crop forecast.
 Onions, final report on commercial acreage and production, 1915-16.
 Potatoes, per cent moved from county where grown.
 Potatoes, when harvested.
 Potatoes, stocks on January 1, 1910-1916.
 Strawberries, commercial acreage and production.
 Tomatoes, commercial acreage and production.
 Truck crops, winter, condition of.
 Truck crops for canning.
 World potato crop, shortage in 1916.

Apples:

Apple crops, 1915-16, disposition of.
 Apple forecast, by varieties.
 Production and exports.

Sugar beets:

Acreage report.
 Sugar beet and beet sugar, crops, 1914-1916.
 Sugar-beet seed, area and production.

Sugar cane, Louisiana.

Sugar crop, Hawaii.

Hops:

Production and consumption, 1907-1916.
 Washington report.

Honey:

Honey bees and plants.
 Honey production.
 Honey yield and prospects.

Pecans:

Condition, July 1.
 Condition, September 1.
 Pecan production.

Live stock:

Hogs in United States, September 1, 1915-16.
 Hogs marketed, monthly since 1911.
 Live stock, marketings, 1900-1916.
 Live stock, Philippines.
 Meat animals and products, foreign trade in.
 Wool, high prices for.
 Wool production, 1915-16.

Prices:

Alfalfa seed, prices.
 Bean prices, usual advance in.
 Clover seed, prices.
 Cotton and cottonseed prices to producers by States, averages five years.
 Index figures of crop prices.
 Index prices of meat animals.
 Milk prices.
 Prices, index number of crops, trend since 1908.
 Prices, monthly, 1910-1916, of important farm products.
 Turkey prices.

Values:

Farm lands, value per acre, 1912-1916.
 Farm production, estimated value of, 1916.
 Farm products, estimated value, 1879-1916.

Miscellaneous:

Alsike clover growing.
 Area covered by reports of voluntary correspondents.
 Commercial fertilizer sold in cotton States.
 Composite crop conditions, monthly, 1910-1916.
 European and United States agriculture compared.
 Fertilizer, application in cotton States.
 Firewood, use on farms.
 Foodstuffs, production, consumption, and trade in.
 Garlic, commercial acreage.
 Grain crops, method of gathering.
 Hemp production.
 Increase of population of United States compared with increase in production of 12 leading crops.
 Index figures of crop yields.
 Large crop yields per acre.
 Materials used to make alcoholic liquors in United States, 1915-16.
 Number of gas tractors in commission on farms.
 Orange and grapefruit crop.
 Peanut acreage.
 Philippine fiber crops, 1915.
 Production, price, and value changes.
 Sizes of family and farming in Iowa County, Wis.
 Trend of farm prices and yield per acre of crops combined.
 Wages of male farm labor.
 World production of important crops.

INTERNATIONAL INSTITUTE OF AGRICULTURE.

Twenty-four regular reports on crops of the United States were made by cable and mail to the International Institute of Agriculture at Rome, Italy, and statistical tables were contributed to the yearbook of the institute. In addition to printed reports issued by the institute, there were received during the year 16 cablegrams relating to crop production in the adhering countries of the world, which were interpreted and presented to the press through the Office of Information.

PUBLICATIONS.

Twelve numbers of the Monthly Crop Report were issued during the year, aggregating 140 quarto pages of estimates and agricultural statistics.

Two hundred and five statistical tables were prepared for publication in the department yearbook for 1916.

The following department bulletins were published:

- No. 473.—Production of sugar in the United States and foreign countries.
- No. 483.—Statistics of fruits in principal countries.
- No. 485.—Apples: Production estimates and important commercial districts and varieties. (Prepared in cooperation with the Bureau of Plant Industry.)
- No. 514.—Wheat, yields per acre and prices, by States, 1866-1915.
- No. 515.—Corn, yields per acre and prices, by States, 1866-1915.

An article was contributed to the department yearbook for 1916 on the development and localization of truck crops in the United States.

The following manuscripts were submitted just before the close of the fiscal year 1917:

Potatoes: Acreage, production, foreign trade, supply, and consumption, by George K. Holmes; and Geography of wheat prices, by L. B. Zapoleon.

DISTRIBUTION OF THE MONTHLY CROP REPORT.

The agricultural appropriation act approved March 4, 1917, provided "that hereafter the Monthly Crop Report shall be printed and distributed on or before the 12th day of each month." The crop reports relate to conditions on the 1st day of the month, and the individual schedules are filled out and mailed on that date. The returns from the Pacific Coast States are received about the 6th, and the tabulation of returns from all States in the bureau is completed about the 7th or 8th of the month, when the report is made up by the crop-reporting board, the date depending on the occurrence of a Sunday or holiday. The manuscript of the Monthly Crop Report is completed and forwarded to the Public Printing Office on the afternoon of the same day the preliminary report is issued by the Department of Agriculture, so that four or five days are allowed for the printing and mailing of the report. The enactment of the law by Congress requiring the report to be printed and mailed on or before the 12th of each month insures the prompt delivery of printed copies to all voluntary crop reporters and others on the mailing list. Because of the prompt mailing of the reports in compliance with the law the telegraphic reports to Weather Bureau station directors of near-by States was discontinued.

LIBRARY.

The library of the Bureau of Crop Estimates, which is a branch of the library of the department, during the fiscal year received approximately 250 foreign and 300 domestic periodicals containing useful information regarding agricultural statistics. Of these periodicals about 202 were monthly, 138 weekly, 41 daily, and the remainder were issued at other periods. The foreign periodicals received were about 50 less than in the fiscal year 1916, a decrease of about 16½ per cent owing to war conditions.

The books in the library comprise the agricultural reports of practically all countries issuing such reports; also a fairly complete collection of the official reports of exports and imports for each foreign country. The collection of State reports on agriculture and live stock is practically complete; also annual statistical reports of commercial agencies, such as boards of trade, chambers of commerce, cotton exchanges, etc.

ACCURACY OF THE COTTON CROP ESTIMATES.

Cotton is the only crop for which there is an absolute check on the estimates of the Bureau of Crop Estimates. The latest preliminary estimate of the number of bales produced each year is prepared and published early in December. The Bureau of the Census, Department of Commerce, is required by law to report every bale of cotton ginned, and its final report is published after the close of the ginning season, three months or more after the December estimate of production is issued. The following table shows the increasing accuracy of the cotton estimates of the Bureau of Crop Estimates

when compared with the reports of the Census Bureau of bales actually ginned:

Number of pounds of lint cotton (net weight) as estimated in December, annually, by the Bureau of Crop Estimates, and as subsequently reported by the Bureau of the Census, for each of the seasons 1900-1901 to 1916-17, inclusive, together with the percentage overestimated or underestimated by the Bureau of Crop Estimates each season.

Crop year.	Pounds of cotton (000 omitted).		Over-estimated.	Under-estimated.
	Estimated by Bureau of Crop Estimates.	Finally reported by Census Bureau.		
1900-1901.....	4,856,738	4,846,471	<i>Pcr cent.</i> 0.2	<i>Pcr cent.</i> 0.5
1901-2.....	4,629,954	4,550,950	.....	.....
1902-3.....	6,111,370	5,091,641	0.4	.....
1903-4.....	4,882,796	4,716,591	3.7	.....
1904-5.....	6,157,064	6,426,698	.....	4.2
1905-6.....	4,880,217	5,060,200	.....	4.0
1906-7.....	6,001,726	6,354,110	.....	5.5
1907-8.....	6,581,068	5,312,950	5.1	.....
1908-9.....	6,182,070	6,336,070	.....	2.4
1909-10.....	4,826,344	4,783,220	0.9	.....
1910-11.....	6,464,597	5,551,790	.....	1.6
1911-12.....	7,121,713	7,506,430	.....	5.1
1912-13.....	6,612,335	6,556,500	0.9	.....
1913-14.....	6,542,350	6,772,350	.....	3.4
1914-15.....	7,637,113	7,718,980	.....	1.1
1915-16.....	5,338,588	5,354,406	.....	0.3
1916-17.....	5,506,396	5,480,012	0.4	.....
17 years, 1900-1916.....	97,222,739	98,419,369	.....	1.2
5 years, 1912-1916.....	31,637,782	31,882,248	.....	0.8
3 years, 1914-1916.....	18,482,597	18,553,398	.....	0.6

ACCURACY OF THE RICE CROP ESTIMATES.

In order to determine the accuracy of the department's estimate of rice production for 1915, issued in December of that year, and thereby afford to the Bureau of Crop Estimates the basis for any adjustments necessary to increase the accuracy of its estimates in future years, requests were sent to all rice mills that they report their receipts of rough rice from the crop of 1915. Returns have been received for every rice mill of importance in the United States, showing—

Total mill receipts of rough rice in bushels of 45 pounds each.....	Bushels. 27,396,991
Seeding requirements for present year, approximately.....	1,765,800
Mills reporting (estimate for one) show sales for seed of.....	223,578
Leaving to be furnished by local elevators or retained by farmers for seed.....	1,542,222
Production of rice east of Mississippi River, not including river rice in Tennessee and Mississippi, but including upland rice in the latter State, is estimated at.....	160,000
Deducting factors for this territory already considered, viz., mill receipts and seed requirements.....	104,000
Leaves further to be added.....	56,000
Thus accounting definitely for a total of.....	28,995,213
Total production as estimated by Bureau of Crop Estimates in De- cember, 1915, was.....	28,947,000
Showing an excess over the bureau's estimate of.....	48,213
Or about two-tenths of 1 per cent.	

IMPROVEMENT IN ORGANIZATION AND EQUIPMENT FOR ESTIMATING CROP AND LIVE-STOCK PRODUCTION.

Methods of improving the crop-reporting service are constantly under consideration in the Bureau of Crop Estimates. As pointed out in previous annual reports of this bureau, the most difficult problem encountered in crop reporting is an attempt to estimate acreages planted to different crops and the numbers of different classes of live stock on farms; also such special crops as truck and fruit. To take an annual census of acreages and live stock can not be considered because of the enormous expense involved and the time required to compile and publish the results. Returns of local tax assessors in the various States are not always complete, uniform, or available when needed. In lieu of an annual census enumeration the best substitute appears to be an organization or system of reporting for definite areas under the constant observation of field agents who are trained in crop-reporting methods, supplemented by reports of large numbers of individual farmers distributed throughout each area, and by reports of trained specialists on each crop. This in effect is the system at present employed in the Bureau of Crop Estimates. Obviously the smaller the territory assigned to each field agent, or what means the same thing, the greater the number of field agents assigned to a given territory, the more thoroughly the acreages and condition of crops and the numbers of different classes of live stock can be studied, and the more satisfactory will be results. That better results can be secured from a smaller division of territory has been fully demonstrated since the bureau has had a trained field agent in each of the principal agricultural States, instead of one agent for a group of States, as formerly. However, it is evident that even a single State in the important producing areas is entirely too large for one man to cover effectively.

If sufficient funds were available to develop fully and perfect the crop-reporting service it would be highly desirable to give the field agent in each State one or more trained assistants, so that the State could be divided into districts and a survey made of its agricultural resources and production by counties.

The efficiency of the field service would be vastly improved if funds were provided for the employment of a local agent in each county who could devote a portion of his time to estimating crop and live-stock production in the county. While the bureau has a county crop reporter in each county, his services are purely voluntary and he can not be expected to lay aside his regular work to undertake systematic inquiries throughout the county for the benefit of the Government. The county agents of the States Relations Service are unable to devote sufficient time to the study of acreages, crop conditions and yields, numbers of live stock and supplies on farms in their counties to be of much service in crop reporting, because their position of farm advisers and relation to best methods of farm management, crop and live-stock production, requires all their time, energy, and attention. If county crop reporters could be given sufficient compensation to justify them in devoting a portion of their time exclusively to collecting detailed information with respect to crops and live stock, the bureau would be in much better position to issue its monthly and special reports by counties.

It would also be desirable to provide the field agent in each State with a clerk to assist in folding and mailing schedules of inquiry, opening and tabulating returns, and in handling correspondence and other necessary office work, so as to relieve the field agents of the burden of routine details and leave them free to devote their entire time to the more important and difficult work of studying, analyzing, estimating, and forecasting crop conditions and prospects.

Field agents should be supplied with automobiles. Crop estimates can not be made entirely from written reports of correspondents, nor can the field agent judge of the condition and probable yield of a crop from the fleeting glance he gets through a car window when speeding across the country between cities and towns. During the growing season, especially at critical periods in the life history of a crop, field agents must get out in the fields and examine individual plants. The greater the number of fields examined the more accurate will be the field agent's judgment of the extent of damage from various causes. At the present time field agents travel from town to town by rail or trolley, and at each point it is usually necessary to hire a conveyance to go out in the country. Trains run at irregular intervals, and it is often difficult to obtain a conveyance at stopping points. The agent can inspect only a small territory in the vicinity of a town and often loses much time waiting for trains. The use of automobiles by agents would obviate many of these difficulties, and by enabling the field agent to visit crop-producing areas not readily accessible by railway, with power to stop at any point en route to examine particular fields, would increase the efficiency and dependability of the service many fold.

It is highly desirable also that the clerical force in Washington should be increased in order to handle properly the increased number of returns from the field force and to meet the increasing demands which are constantly being made upon the bureau for special investigations. Irrespective of whether the field force is increased, the desirability of a substantial increase in the clerical force of the bureau is becoming more and more apparent. During the past decade the volume of work to be done has nearly doubled and is likely to increase as the agriculture of the country develops and as interest grows in the production and consumption of agricultural products. The public demand for estimates of crop and live-stock production and supplies of food and feed, farm help, seed, fertilizer, farm machinery, and other factors relating to the present and future food supply, has been constant and insistent since the beginning of the European War. This demand has been relatively greater than the increase in the clerical and field force authorized by Congress in the past few years. The fact that the crop-reporting service has been able to meet the increasing demands upon it with its present inadequate force is due largely to the cooperation of public-spirited men in every community who serve as voluntary crop reporters without monetary compensation, and to the loyal and efficient service of employees in the field and in the Washington office, who cheerfully work more than the customary office hours and on Sundays and legal holidays when necessary to tabulate returns in order to get the crop reports out promptly.

CROP REPORTS BY COUNTIES.

In undertaking special investigations and in planning future work the Bureau of Crop Estimates is guided mainly by the number, urgency, and purpose of requests which are received for special information. The increasing number of requests from all sources for information by counties indicates clearly that the crop and live-stock estimates would be greatly enhanced in value, interest, and service if the estimates by States could be made to show details by counties. Estimates can be made readily and published in this form if the bureau can be provided with a relatively slight increase in funds and equipment.

In the spring of 1917 a cooperative arrangement was effected between the Bureau of Crop Estimates and the State department of agriculture of Wisconsin, which provides for the utilization of all State sources of information by the field agent of the bureau in that State in collaboration with State officials, the preparation of a monthly State crop report by counties in conformity with the totals for the State, as determined by the Crop Reporting Board of the bureau and telegraphed to the field agent as soon as the crop report is approved and issued by the Secretary of Agriculture, and the cooperative State county crop report is then immediately published by the Wisconsin State department of agriculture.

It is hoped that sufficient funds and facilities may be provided in the near future as will enable the bureau to complete the organization of the crop-reporting service on a county basis by the time the next census of agriculture is taken, and that thereafter all crop and live-stock estimates of the Department of Agriculture can be made to show details by counties.

REPORT OF THE LIBRARIAN.

UNITED STATES DEPARTMENT OF AGRICULTURE.

OFFICE OF THE LIBRARIAN,

Washington, D. C., September 29, 1917.

SIR: I have the honor to submit herewith the executive report of the Library for the fiscal year ended June 30, 1917.

Respectfully,

CLARIBEL R. BARNETT,
Librarian.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

Abnormal conditions due to the war have had a noticeable effect upon the work of the Library for the past year. The scientific work of the department has naturally been affected to a certain extent and this has reacted upon the Library. For the first time since 1905, when the Library began to keep circulation statistics, there was no increase—in fact there was a small decrease—in the number of books charged at the loan desks. The reference work of the Library, on the other hand, has greatly increased, due no doubt largely to the fact that the war has brought up new problems and new subjects for investigation. A decrease of about 300 in the number of foreign periodicals currently received during the past year, due to the war, easily explains the decrease in the number of periodicals circulated currently.

During the fall a large number of herd books formerly filed in the Division of Animal Husbandry, and also several sets of periodicals formerly filed in the Bureau of Biological Survey, were returned to the Library. The crowded condition of the shelves made it necessary, before the books could be put in place, to add some additional wooden shelving for the basement stacks, and on the tops of the Snead stacks on the first floor. The need for additional space for book stacks is pressing, and some provision for larger quarters for the Library must be made in the near future. The only adequate solution is a permanent fireproof building especially designed for the Library.

USE OF THE LIBRARY.

EMMA B. HAWKS, *Assistant Librarian, in general charge of reference work and circulation.* MARY G. LACY, *Reference Librarian.* GERTRUDE E. UPTON, *in Charge of Loan Desk.*

Since circulation statistics are not kept in all of the bureaus, divisions, and offices, and since it is also impracticable to keep any record of the reference use of the collections filed in the Library and the

various offices, the statistics of circulation given in the following tables do not give an adequate idea of the real use of the Library. The total number of books charged to individuals, namely, 52,997, added to the total circulation of current periodicals, 116,936, making a grand total of 169,933, represents simply the recorded use of the Library. The remaining charges represent merely the record of the books shifted from one branch of the Library to another, either for filing or to fill the request of some reader. In the latter case, the record of its use is given in the charges to individuals. The record of the charges from the bureaus to the main Library shows that it was necessary for the main Library to recall 2,529 books from various bureau collections for the use of the bureaus.

STATISTICS OF CIRCULATION.

Books and periodicals charged by the main Library and the bureau, division and office libraries during the fiscal years 1916 and 1917.

	Number of books charged.								Number of periodicals charged.	
	To individuals.		To main Library.		To branch libraries.		Total.			
	1916	1917	1916	1917	1916	1917	1916	1917	1916	1917
Main Library ¹	14,996	16,192	-----	-----	33,918	30,147	48,914	46,339	-----	-----
Bureau of Animal Industry: ²										
Animal Husbandry Division.....	(³)	(³)	(⁴)	(⁴)	(⁴)	(⁴)	-----	-----	(⁵)	3,666
Dairy Division.....	1,909	1,975	56	48	38	17	2,008	2,040	12,820	10,176
Biochemic, Pathological, Zoological, and other divisions.....	(³)	(³)	(⁴)	(⁴)	(⁴)	(⁴)	(⁵)	(⁵)	19,409	11,096
Bureau of Chemistry.....	9,751	9,627	765	889	17	14	10,533	10,330	19,244	15,246
Bureau of Entomology.....	4,680	3,105	446	522	104	131	5,230	4,550	1,292	905
Forest Service.....	3,550	3,495	369	422	-----	2	3,919	4,094	4,548	4,809
Bureau of Plant Industry.....	14,930	11,684	979	666	180	34	16,099	12,521	43,275	38,398
Office of Farm Management.....	3,462	3,922	-----	-----	-----	-----	3,462	3,922	7,802	7,793
Office of Markets and Rural Organization.....	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	(⁴)	19,495	20,987
Office of Public Roads and Rural Engineering.....	2,863	2,997	178	182	12	12	3,053	3,181	(⁴)	4,566
	56,141	52,997	2,793	2,529	34,269	30,357	93,213	86,977	127,885	116,936

¹ Statistics include circulation in all bureaus and offices not mentioned below.

² No bureau library is maintained. The statistics of circulation of books are included in those of the main Library.

³ Circulation statistics included in statistics of main Library.

⁴ No records kept.

⁵ Statistics for only 10 months.

The following table indicates the growth in the work of the circulation division of the main Library during the past five years:

Statistics of circulation (main Library), fiscal years 1913 to 1917.

	1913	1914	1915	1916	1917
Largest number of books charged on any day.....	203	214	268	248	317
Smallest number of books charged on any day.....	31	39	37	57	32
Average number of books charged daily.....	121	126	134	160	151
Largest number of books charged in any month.....	4,106	4,454	4,260	5,028	4,839
Smallest number of books charged in any month.....	2,269	2,083	2,567	3,077	2,883
Average number of books charged monthly.....	3,078	3,239	3,412	4,076	3,861
Total number of books charged during the year.....	36,933	38,879	40,953	48,914	46,339

During the year there were 1,815 individuals in the department who borrowed books either through the main Library or the branches in the various bureaus, divisions, and offices, an increase of 285 as compared with the previous year. To 1,200 of these registered borrowers current periodicals were circulated regularly. Increasing numbers of books are being used outside of Washington as evidence in court cases of the department. The two largest shipments of books and pamphlets sent out for this use during the past year were 100 volumes sent to New Orleans, La., and 87 volumes sent to Auburn, N. Y., in connection with important cases of the Bureau of Chemistry.

INTERLIBRARY LOANS.

There were 12 libraries, institutions, and Government departments in Washington which made use of the Library's resources during the past year. The records of books lent to institutions outside of Washington are given in the following table, from which it will be seen that, with three exceptions, books were lent last year to every State in the Union. The number of different institutions to which they were lent was 103, and in addition 13 business firms and 46 individuals made use of the Library, making a total of 162 different borrowers from outside of the city. To the total number of books lent, namely, 1,093, should be added 168 photostat copies and 12 typewritten copies of articles which were furnished, making the total use outside of the city 1,273. The number of books requested which were not contained in the Library was 190. The number which could not be supplied because they were in use or at the bindery was 63. In addition, 38 could not be supplied because the references could not be identified.

Record of books lent outside of Washington during the fiscal years 1913 to 1917.

States, etc.	Fiscal year—					States, etc.	Fiscal year—				
	1913	1914	1915	1916	1917		1913	1914	1915	1916	1917
Alabama.....		3	3		10	New Mexico.....	1	4	3	9	8
Arizona.....	7	6	4	14		New York.....	59	113	142	127	148
Arkansas.....			2	3	4	North Carolina.....	35	30	48	17	15
California.....	19	27	26	50	38	North Dakota.....	6	11	8	11	3
Colorado.....	9	12	27	24	16	Ohio.....	53	103	78	29	41
Connecticut.....	16	4	4	2	2	Oklahoma.....					
Delaware.....	11	18	11	10	6	Oregon.....	54	44	51	66	51
Florida.....	27	20	44	21	15	Pennsylvania.....	34	19	21	29	19
Georgia.....	1	14	15	37	24	Rhode Island.....			6	2	17
Idaho.....	3	5	9	5	10	South Carolina.....	6	1	1	22	27
Illinois.....	6	12	7	66	30	South Dakota.....			3		
Indiana.....	7	7	25	20	13	Tennessee.....	16	26	20	31	22
Iowa.....	36	24	63	80	40	Texas.....	10	9	23	11	38
Kansas.....	8	12	59	71	38	Utah.....			8	17	16
Kentucky.....	6	4	25	7	4	Vermont.....	27	30	21	9	3
Louisiana.....	5	2	2	10	3	Virginia.....	52	54	32	26	18
Maine.....	7	11	8	22	16	Washington.....	3	14	8	11	2
Maryland.....	12	7	25	28	48	West Virginia.....	10	2	12	16	8
Massachusetts.....	14	18	36	25	33	Wisconsin.....	89	31	38	41	34
Michigan.....	37	35	22	37	38	Wyoming.....	2		4	5	3
Minnesota.....	2	7	64	78	50	Canada.....			1		1
Mississippi.....	4	3	4		1	Hawaii.....	2	2			3
Missouri.....	17	19	18	15	19	Porto Rico.....	39	67	57	43	39
Montana.....	15	13	5	15	19	Canal Zone.....		1			
Nebraska.....	32	20	20	18	10	Alaska.....				2	
Nevada.....				3	1						
New Hampshire.....	8	5	3	2	8	Total.....	826	896	1,196	1,240	1,093
New Jersey.....	1	24	83	53	76						

An informal record was kept during the year of the number of letters from outside the city received each day requesting inter-library loans. It was found that with the exception of 47 days at least one request was received every day, and that the average was two a day, the total being 745 for the year. That the privilege of borrowing books from this Library is especially appreciated by some of the State agricultural experiment stations is shown by the following extract from one of the recent station reports:

The station is greatly crippled on account of the exceedingly small library from which the staff has to draw. This is partly overcome by borrowing from the United States Department of Agriculture Library. * * * Without the use of the books and periodicals which are thus borrowed the men would be forced many times to delay the work for weeks.

As in previous years, the department has in turn been the recipient of many favors in the matter of interlibrary loans from university and reference libraries outside of the city, in addition to those from the Library of Congress and other Government libraries. A comparative statement of this use during the past five years is shown in the following table:

Summarized statement of books borrowed from other libraries during the fiscal years 1913 to 1917.

	1913	1914	1915	1916	1917
Largest number of books borrowed from other libraries on any day..	43	40	42	42	41
Average number of books borrowed from other libraries daily.....	18	16	18	23	19
Largest number of books borrowed from other libraries in any month..	731	564	579	734	623
Average number of books borrowed from other libraries monthly....	480	432	460	571	507
Number of books borrowed during the year from libraries outside of Washington.....	91	62	58	86	82
Number of books borrowed during the year from other libraries in Washington.....	5,677	5,166	5,463	6,774	6,010
Total number of books borrowed from other libraries in and out of Washington.....	5,768	5,228	5,521	6,860	6,092

Of the 6,092 books borrowed from libraries in the city during the year 4,629 were borrowed from the Library of Congress, 962 from the Surgeon General's library, 141 from the National Museum and Smithsonian Institution, 57 from the Geological Survey, 49 from the Patent Office, 41 from the Bureau of Education, and the remaining 213 from 15 other Government libraries. Of the 82 borrowed from libraries outside of the city 19 were borrowed from the Lloyd Library and the remaining 63 from 17 other university and reference libraries in Cambridge, Boston, New York, Philadelphia, Baltimore, Chicago, St. Louis, and Berkeley. Grateful acknowledgment is made to all libraries which have so generously aided the department in its work by lending books from their collections.

ACCESSIONS.

The number of books, pamphlets, and maps added to the Library during the past fiscal year, compared with the accessions of the four previous years, is as follows:

Accessions to the Library for the fiscal years 1913 to 1917.

Accessions.	1913	1914	1915	1916	1917
Purchases:					
Volumes.....	1,321	1,548	1,353	1,595	1,949
Pamphlets.....	51	41	39	49	76
Maps and charts.....	1	1	.....	13	1
Serials and continuations.....	459	511	376	274	147
Total.....	1,832	2,101	1,768	1,931	2,168
Gifts:					
Volumes.....	886	719	780	873	641
Pamphlets.....	830	470	500	397	508
Maps.....	28	20	22	18	4
Continuations.....	4,425	4,480	4,909	4,919	4,458
Total.....	6,109	5,699	6,211	6,207	5,611
From binding periodicals and serials.....	1,573	1,826	1,085	1,612	1,178
Total.....	9,574	9,626	9,064	9,750	8,957

According to the record of accessions, the total number of books and pamphlets accessioned by the Library up to July 1, 1917, was 148,608. From this number, however, should be deducted 5,910 volumes which were discarded during the fiscal year 1915 and 321 which were discarded during the past two fiscal years, leaving a balance of 142,377 books and pamphlets in the Library on July 1, 1917.

In spite of the unfavorable conditions for the purchase of old foreign books, the Library was able to obtain a number of old horticultural works during the past year, among them several choice gardening books published between 1578 and 1699, as well as many of later date, like the "Complete Body of Planting and Gardening" of William Hanbury (1770-71). Other important acquisitions were the rare "Synopsis Plantarum Aequatoriensium" by William Jameson, and a set of the "Memorias Economicas" published by the Lisbon Academy of Sciences from 1789 to 1815, which contains a number of papers by Loureiro and Vandelli.

CATALOGUE DIVISION.

HELEN M. THOMPSON, *Chief.*

The record of the material classified and catalogued during the year is as follows: 2,590 volumes, 508 pamphlets, 5,783 serials and continuations, and 5 maps and charts, making a total of 8,957, a decrease of 793 from the preceding year. In addition to the complete cataloguing of the above books, pamphlets, and maps, author cards were made for 216 pamphlets and 1,178 "reprints." The pamphlets for which only author cards are made are those of less importance. They are arranged by subject in a separate pamphlet collection. The "reprints" or "separates" of articles from periodicals are also filed in a separate collection which is arranged alphabetically by author.

There were added to the main (dictionary) catalogue 22,875 cards, and 3,713 were withdrawn, making the net addition of 19,162, a decrease of 2,461 as compared with the preceding year. It is estimated that the main (dictionary) catalogue now contains approximately 370,000 cards.

The number of titles prepared during the past year by the Library for printing by the Library of Congress in what is known as the "Agr" series of catalogue cards was as follows: Cards for accessions and recatalogued books, 806; cards for department publications, 511; cards for foreign agricultural periodicals, 7; total, 1,324. The total number of titles prepared by this Library since 1902, in which year the printing of cards was begun, is 29,858.

The amount of uncatalogued material on hand July 1, 1917, which was an increase over the previous year, was as follows: 126 volumes, 150 pamphlets, 543 continuations, and 9 maps. The cataloguing was hampered by the loss of two cataloguers and the necessity of employing temporary assistants.

During the year some progress was made in reclassifying the books in certain classes in accordance with the expanded classification. About one-third of the books on forestry were done and part of the books on general agriculture.

PERIODICAL DIVISION.

LYDIA K. WILKINS, *Chief.*

The total number of different periodicals, exclusive of annuals and serials of infrequent issue, received currently during the year was 2,219, of which 565 were received by purchase and 1,654 by gift. The number of new periodicals added during the year was 319, whereas 380 of those on last year's list are no longer received, either because they have ceased publication permanently or temporarily, or because the subscriptions for them have been discontinued. There was a net decrease for the year of 61. In order to meet the demand for certain periodicals it was necessary to purchase 186 duplicates, making the total number of periodicals purchased 751, a decrease of 247 as compared with the number purchased during the previous fiscal year. This decrease in the number of purchased periodicals received during the year is due to the fact that since May, 1916, the Library's agent for the foreign periodicals has been unable to deliver German periodicals and also many periodicals of other countries. Of the periodicals received by gift or exchange over 844 duplicates were received, an increase of 273 as compared with the previous year.

Although the number of different periodicals received during the year was 61 less than the number received last year, yet the total number of periodicals received, including duplicates, was 3,249, an increase of 234 over last year. This increase is due to the fact that more periodicals were purchased in duplicate this year and more duplicates were received by gift and exchange. The duplicate copies were necessary partly for the use of the offices which have moved to buildings at a distance from the Library, and partly because of the great increase in the use of commercial papers which must be received promptly to be of value, so that many copies were needed for circulation. Many periodicals which in previous years have been received by gift and exchange it was necessary to purchase this year, since the publishers discontinued sending complimentary copies.

In addition to the 2,219 current periodicals appearing not less than four times a year, the Library received 4,605 serials of less frequent

issue, such as annual reports, proceedings, and transactions published by institutions and societies. There was a decrease of 501 as compared with the previous year, due to the fact that on account of the war fewer foreign publications were received.

A typewritten list of all the periodicals currently received by the Library, arranged by title and subject, was prepared during the year. This list has been much used and has demonstrated the need of a new edition of the printed list of current periodicals which was issued in 1911 as Library Bulletin 75. It has not, however, seemed advisable to issue a new edition during the war, on account of the large number of foreign periodicals which either have been temporarily suspended or can not be delivered under present conditions.

The number of current periodicals received, arranged by classes, is shown in the following table:

Statistics of current periodicals.

Class.	Pur- chase.	Gift.	Total.	Class.	Pur- chase.	Gift.	Total.
Agriculture, United States...	11	199	210	Flour and feeding stuffs, etc.	6	10	16
Agriculture, foreign...	18	167	185	Ice and refrigeration...	3	7	10
Veterinary medicine...	19	33	52	Paper...	7	2	9
Dairying...	10	26	36	Printing...		4	4
Poultry and pigeons...	3	47	50	Photography...	6	1	7
Live stock and meat trade...	8	51	59	Physics...	4		4
Soils and fertilizers...	1	5	6	Meteorology...		3	3
Drainage and irrigation...	1		1	Chemistry and chemical tech- nology...	35	33	68
Farm implements and ma- chinery...	2	11	13	Food...	6	22	28
Moor culture and peat...	1	6	7	Home economics...	1	6	7
Agricultural products...	20	51	71	Pharmacy...	9	12	21
Fibers and textiles...	5	8	13	Geology and mineralogy...	2	7	9
Horticulture and landscape gardening...	29	66	95	Natural history...	9	32	41
Forestry...	11	44	55	Zoology...	10	17	27
Experiment station publica- tions (United States)...		110	110	Hunting and fishing...	5	7	12
Experiment station publica- tions (foreign)...		25	25	Ornithology...	10	5	15
General...	20	13	33	Entomology...	26	22	48
Bibliography and library economy...	19	13	32	Beekkeeping...	6	7	13
Education, including agri- cultural extension...	3	103	106	Microscopy...	3		3
Economics and sociology...	16	34	50	Biology...	11	8	19
Commerce and statistics...	58	163	221	Medicine, physiology, and hygiene...	36	57	93
Groceries...	8	8	16	Bacteriology...	5	1	6
Engineering...	17	17	34	Botany...	28	22	50
Building...	5	5	10	General science...	14	52	66
Roads...	1	17	18	Geography...	2	6	8
Railroads...	11	17	28	Law...	8		8
Manufactures...	15	33	48	United States Government documents...	1	40	41
				Total...	565	1,654	2,219

DUPLICATES.

As in previous years, the Library received a large number of duplicates, for the most part publications of States, foreign Governments, societies, and institutions, which are sent to the various offices of the department and later transferred to the Library. Two lists of these duplicates were prepared by the Periodical Division and sent to the Library of Congress and to libraries of the State agricultural colleges. The items selected by the libraries from these lists filled 31 mail bags. The work of caring for the duplicates consumes a large amount of time.

BINDING.

FANNY L. PARKER, *in Charge*.

The number of books and periodicals sent to the Government Printing Office for binding was 4,064, an increase of 701 as compared with the previous year. In addition to the books and periodicals permanently bound, 2,000 were laced in temporary binders and 1,728 pamphlets were stapled in pamphlet binders. No record was kept of the large number of reports, missing numbers, etc., added to volumes already in temporary binders. Although a larger number of books were sent to the Government Printing Office than in the previous year, the actual number of volumes returned was less, owing to the fact that many of the books have remained in the bindery six or seven months, the work of the bindery being much congested on account of emergency war requirements.

AFFILIATED ACTIVITIES.

As has been noted in previous reports, the main Library and the bureau and division libraries are charged to a considerable extent with duties which are not ordinarily considered a part of library work, such as editorial work, translating, care of mailing lists, care of photographs and lantern slides, and general secretarial work. These duties may be described as affiliated or related activities.

The main Library has supervision of the foreign mailing lists of the various bureaus, divisions, and offices and has charge of the miscellaneous distribution of the publications of the department sent as exchanges to foreign countries. This work is of direct value to the Library in connection with the work of obtaining exchanges. It is administered as a part of the Periodical Division. The Library maintains a consolidated list, arranged geographically, of all the addresses appearing on the foreign mailing lists of the various bureaus. This list comprises at the present time approximately 3,200 addresses.

Certain of the bureau libraries are also called upon to do work in connection with the distribution of the publications of their respective bureaus, namely, the libraries of the Bureau of Plant Industry, the Bureau of Entomology, the Dairy Division, and the Office of Farm Management. As the domestic mailing lists of the Bureau of Plant Industry are extensive, the care of the lists is an important part of the work of the library of that bureau.

During the latter part of the fiscal year the Library was requested to prepare a subject index to the domestic mailing lists¹ maintained by the various offices of the department, to be used in connection with the emergency distribution of publications made necessary by the war. The making of this index proved an interesting problem, and it is believed that if the plan were further developed it would prove a valuable aid in the distribution of department publications. The present distribution of publications by bureaus lacks flexibility and does not meet satisfactorily the needs of institutions and individuals desiring to receive publications on certain subjects.

¹ The domestic mailing lists are not filed in the library.

The Library is called upon to do a considerable amount of translating. During the last fiscal year 131 letters and 7 articles were translated by the Library up to March 1, 1917, at which time the Library translator resigned. Since that date the letters sent to the Library to be translated have, except in a few instances, been referred to the translator connected with the Editorial Office of the Bureau of Animal Industry, in accordance with a cooperative arrangement made with that office. A translator was recently appointed in the Bureau of Chemistry and is a member of the staff of the bureau library. Translations are being made of the foreign food and drug laws.

By far the heaviest of the affiliated activities of the library of the Office of Markets and Rural Organization has been the editorial work. Fifty-nine publications were edited by the library during the past year. The library also has considerable work in connection with the bureau correspondence.

In the Dairy Division the correspondence files are under the supervision of the librarian of the division. This work has increased almost 50 per cent during the past year and now requires more than one-half the time of two assistants. The photographic collections and lantern slides are also cared for by the library.

LIBRARY STAFF.

The number of employees carried on the roll of the main Library at the close of the year was 35; the number employed by the bureau, division, and office libraries was 44. The total number, 79, employed in the main Library and the bureau, division, and office libraries includes 62 librarians, library assistants, and stenographers, 1 translator, 14 messengers, and 2 charwomen. The only change in personnel of the bureau librarians was in the Bureau of Crop Estimates. The former librarian, Miss Helena C. Spraker, resigned in October, 1916, and was succeeded on November 1 by Mrs. Ellen H. Painter.

During the past year many changes were made in the personnel of the main Library staff, due to resignations. Six of the assistants who resigned had been with the Library for a number of years, among them the translator and the bookkeeper. The loss of these assistants seriously crippled the work of the year. As the Civil Service Commission eligible list of library assistants was exhausted, it was necessary to make a number of temporary appointments.

Library staff meetings were held each month from October, 1916, to June, 1917.

BUREAU, DIVISION, AND OFFICE LIBRARIES.

The following table gives a list of the bureaus, divisions, and offices which maintain libraries, with the names of the librarians, and shows the approximate number of books and pamphlets contained in the various libraries, the number of current periodicals which are sent to them regularly for review or filing, the number of registered borrowers, and the number to which periodicals are regularly circulated. The statistics in regard to the use of the books in the various libraries are given on preceding pages of this report. No bureau libraries are maintained by the Bureau of Animal Industry or the Bureau of Soils. The Weather Bureau library is ad-

ministered separately, and the report is contained in the report of the Weather Bureau. The books and periodicals for the Weather Bureau library are, however, purchased from the appropriation for the Library of the department. The sum of \$1,000 is set aside each year for this purpose. In connection with the figures given below showing the approximate number of books and pamphlets in the various libraries, it should perhaps be explained that the proportion of pamphlets in nearly all of the libraries is large. It is estimated that about one-third of the Library's collections are filed in the various bureaus, divisions, and offices.

Books, pamphlets, and periodicals in bureau, division, and office libraries.

Bureau or office.	Librarian in charge.	Number employed.	Number of books and pamphlets.	Number of periodicals currently received.	Number of registered borrowers.	Number of registered borrowers to whom periodicals are circulated.
Bureau of Animal Industry: ¹						
Animal Husbandry Division.....	Miss Jessie Urner.....	1	² 3,800	² 148	35	35
Dairy Division.....	Miss Margaret Doonan..	3	2,570	304	53	53
Biochemic, Pathological, Zoological, and other divisions.	Miss Elsie Moore ³	1	(⁴)	353	105	99
Bureau of Biological Survey.....	W. H. Cheesman ⁵	2	² 6,850	90	44	44
Bureau of Chemistry.....	Miss Anne E. Draper.....	4	6,800	443	226	124
Bureau of Crop Estimates.....	Mrs. Ellen E. Palinter.....	2	² 10,000	550	30	-----
Bureau of Entomology.....	Miss Mabel Colcord.....	2	15,035	250	162	-----
Bureau of Plant Industry.....	Miss Eunice R. Oberly..	10	² 6,900	600	395	165
Forest Service.....	Miss Helen E. Stockbridge.	2	19,345	73	147	45
Office of Farm Management.....	Miss Cora E. Feldkamp.	4	9,000	205	89	40
Office of Markets and Rural Organization.	Miss Caroline B. Sherman.	6	2,636	306	175	547
Office of Public Roads and Rural Engineering.	Miss Grace Francis.....	1	² 4,800	133	78	34
Office of the Solicitor.....	(⁶)	-----	² 1,700	-----	-----	-----
States Relations Service.....	Miss E. Lucy Ogden.....	6	² 4,500	628	91	53

¹ No bureau library is maintained.

² Approximate figures.

³ Periodical assistant.

⁴ No separate library collection maintained.

⁵ Editor and Librarian.

⁶ No librarian in charge.

All books for the use of the department in Washington are purchased by the Library.¹ All books are catalogued by the main Library, including those filed in the bureaus. The main Library catalogue is, therefore, an approximately complete record of all the library resources of the department.

Books and periodicals for field use, or, in other words, for use outside of Washington, can be purchased from the funds of the bureaus, divisions, and offices. The procedure in regard to the purchase of books for field use is governed by Memorandum No. 62 of the Office of the Secretary. The records in connection with the books and periodicals purchased for use in the field are, in the majority of the bureaus, cared for by the libraries of the bureaus.

During the past year 147 books and 2 maps were purchased for the field libraries of the Bureau of Chemistry, at a cost of \$1,221.18. The enological laboratory formerly maintained by the bureau at

¹ For the law governing the purchase of the books and periodicals for the department, see U. S. Statutes at Large, vol. 30, p. 316.

Charlottesville, Va., was discontinued last year, and the books belonging to it returned to Washington. Several books not previously in the department Library were added to it from this source.

The Forest Service now has 169 field libraries, distributed as follows: Six in the district offices, 145 on the national forests, 11 on the purchase areas in the Southern Appalachian and White Mountains, six at the experiment stations, and one at the forest-products laboratory at Madison, Wis. During the past year three national forest libraries and one experiment station library were discontinued, their headquarters having been abandoned or combined with others. There are 31,170 field library books altogether, an increase of 1,573 over the total of last year. The majority of these consist of free Government or State publications. The amount spent by the Forest Service for books and subscriptions to periodicals for the field during the year was about \$2,000, more than one-half of this amount being for periodicals.

Previous to this year little work has been done with the field offices of the Office of Markets and Rural Organization. With the development of the 32 offices of Federal grain supervision, however, such work has become important and at times pressing. A few reference books have been bought for each station, the books being handled and recorded in the library of the office before being mailed to the field. A selected collection of Federal and State bulletins has also been made for each station, and subscriptions for about six well-known grain periodicals have been entered for each. Reference books have also been provided for the branch stations dealing with perishables and those dealing with live stock and meat.

There are 100 field-station collections in the Bureau of Plant Industry, containing approximately 2,200 volumes. The periodicals subscribed for by the bureau for use in the field stations number 285.

There were few changes in the past year in the location and organization of the libraries of the various bureaus, divisions and offices. The Division of Animal Husbandry was moved in May from 1358 B Street SW. to the Busch Building at 710 E Street NW., and a larger room was furnished for the use of the library. In June, 1917, the library and reference work relating to the Office of Grain Standardization, which had been conducted in the Bureau of Plant Industry, was consolidated with that of the Office of Markets and Rural Organization, preparatory to the formal transfer of work, which took place on July 1, at which time the name was changed to the Bureau of Markets Library.

In order better to coordinate the library work of the department and to bring greater cooperation, provision was made by law a few years ago whereby it is legally possible for assistants from the main Library to be detailed temporarily to the bureau and office libraries and librarians from the bureaus and divisions to be detailed to the main Library. Advantage was again taken of this provision during the past year in the temporary transfer of an assistant from the loan desk of the main Library to the Bureau of Plant Industry, and the transfer of a loan-desk assistant from the Bureau of Plant Industry to the main Library. The experience thus gained was helpful to both libraries.

FINANCES.

A comparison of the receipts and expenditures of the Library for the last five years is given in the following table:

Financial statement, fiscal years 1913 to 1917.

RECEIPTS.

Source of receipt and object of expenditure.	Fiscal year—				
	1913	1914	1915	1916	1917
Source:					
Library appropriation.....	\$41,280.00	\$43,520.00	\$45,380.00	\$46,020.00	\$49,500.00
From department printing and binding fund.....	13,843.31	11,345.84	10,190.62	9,662.12	8,707.52
Total.....	55,123.31	54,865.84	55,550.62	55,682.12	58,227.52

EXPENDITURES.

Object:					
Books and serials.....	\$6,825.71	\$9,100.00	\$8,512.15	\$9,117.24	\$10,233.21
Periodicals.....	3,606.48	4,232.41	3,511.18	4,154.11	4,249.99
Maps.....					215.00
Index cards.....	215.86	168.03	181.56	161.15	129.61
Supplies and repairs.....	313.27	556.98	384.55	384.80	435.97
Furniture, shelving, and miscellaneous equipment.....	2,643.89	904.73	3,112.18	699.67	584.50
Traveling expenses.....	29.52			31.20	
Freight, express, and drayage.....					10.04
Salaries (main library).....	27,140.27	28,377.17	29,585.50	31,278.06	33,026.53
	40,775.00	43,339.28	45,287.12	45,826.23	48,883.86
Printing.....	4,084.21	1,892.25	1,895.47	1,806.79	1,727.17
Binding.....	9,759.10	9,453.59	8,295.15	7,855.33	6,980.35
	13,843.31	11,345.84	10,190.62	9,662.12	8,707.52
Total.....	54,618.31	54,685.12	55,477.74	55,488.35	57,591.37

¹ Approximate figures.

From the total, \$6,980.35, spent for binding in the past year, \$5,178.19 was spent for regular binding, \$1,472.66 for binders, and \$329.50 for pamphlet boxes. From the \$1,727.17 spent for printing, \$56.63 was spent for the printing of the annual report of the Librarian for 1916, \$270.54 for forms, and \$1,400 for the cards printed, through the Library of Congress, for the publications of the department and for the accessions.

A. L. A. FORM FOR LIBRARY STATISTICS.¹

Annual report for year ended June 30, 1917.

Name of library, U. S. Department of Agriculture Library.

City or town, Washington, D. C.

Terms of use, free for lending to department employees, free for general reference.

Total number of agencies, 14 (consisting of main Library and 13 branches).

Number of days open during year, 306.

Hours open each week for lending, 45 for nine months, 41½ during three summer months.

Hours open each week for reading, 45 for nine months, 41½ during three summer months.

Total number of staff, 35 in main Library, 44 in branches.

Number of volumes added during year by purchase, 1,949.

Number of volumes added during year by gift and exchange, 641.

Number of volumes added during year by binding material not otherwise counted, 1,178.

Number of volumes withdrawn during year, 249.

Number of pamphlets added during year, 584.

Number of serials added during year, 5,783.

Number of maps and charts added during year, 5.

Total number of books and pamphlets, 142,377.

Total recorded use, 169,933.

Number of interlibrary loans, 1,273.

Total number of registered borrowers, 1,815.

Number of periodicals currently received, 2,219 titles, 3,249 copies.

FINANCE.

RECEIPTS.	PAYMENTS FOR—
Government appropriation \$49,520.00	Books ----- \$9,233.21
From department printing	Periodicals ----- 4,249.99
and binding fund----- 8,707.52	Other serials----- 1,000.00
	Salaries, library service--- 33,025.53
	Printing and binding----- 8,707.52
	Other maintenance ----- 1,375.12
Total----- 58,227.52	Total----- 57,591.37

¹ Libraries which print their annual reports are requested by the American Library Association to include therein their statistics presented according to a form compiled by the American Library Association Committee on Library Administration, as this facilitates comparison. The statistics of the Library are given above in the American Library Association form in so far as the records kept by the Library make it possible.

REPORT OF THE DIRECTOR OF THE STATES RELATIONS SERVICE.

UNITED STATES DEPARTMENT OF AGRICULTURE,
STATES RELATIONS SERVICE,
Washington, D. C., July 1, 1917.

SIR: I have the honor to present herewith the report of the States Relations Service for the fiscal year ended June 30, 1917.

Respectfully,

A. C. TRUE, *Director.*

HON. D. F. HOUSTON,
Secretary of Agriculture.

INTRODUCTION.

The States Relations Service represents the Secretary of Agriculture in his relations with the State agricultural colleges and experiment stations under the acts of Congress granting funds to these institutions for agricultural experiment stations and cooperative extension work in agriculture and home economics, and in carrying out the provisions of acts of Congress making appropriations to the Department of Agriculture for farmers' cooperative demonstration work, investigations relating to agricultural schools, farmers' institutes, and home economics, and the maintenance of agricultural experiment stations in Alaska, Hawaii, Porto Rico, and Guam.

The organization of the service includes the following offices: (1) The Office of the Director, which deals with the general business and administration of the service and the work relating to agricultural instruction and farmers' institutes; (2) the Office of Experiment Stations; (3) the Office of Extension Work in the South, including the farmers' cooperative demonstration work and the cooperative extension work in 15 Southern States; (4) the Office of Extension Work in the North and West, including the farmers' cooperative demonstration work and the cooperative extension work in 33 Northern and Western States; and (5) the Office of Home Economics, including investigations relative to foods, clothing, and household equipment and management.

During the year ended June 30, 1917, the service directly administered appropriations aggregating \$1,529,680, and had administrative

and advisory relations regarding the expenditure of \$3,020,000 of Federal funds (\$1,440,000 for agricultural experiment stations and \$1,580,000 for cooperative extension work) and \$1,100,000 of State funds used as an offset for Federal funds under the extension act of May 8, 1914. In addition, the agricultural colleges and stations used in experimental and extension enterprises over \$6,250,000 derived from sources within the States.

On June 30, 1917, the force carried on the rolls of the States Relations Service aggregated about 2,500 employees. The State agricultural experiment stations employed about 1,900 persons, of whom about 600 did some extension work. The total number of persons employed in cooperative extension work in agriculture and home economics was about 3,500, of whom about 2,300 were carried on the rolls of the States Relations Service.

During the last year the work of the service and the cooperating colleges, experiment stations, and other organizations was materially increased and modified by conditions growing out of the European war. The reduced yield of important staple crops in the United States in 1916 due to adverse climatic and other conditions, combined with the greatly increased need of European peoples for these products, made it necessary for the department and the State agricultural institutions to modify and intensify their plans and activities relating to the agriculture of this country in 1917. This necessity was vastly augmented when the United States entered the war, and it became essential to organize its agricultural forces on a war basis and to instruct the people in both city and country how best to utilize and conserve a limited food supply. To a remarkable extent the people throughout the country turned to the Department of Agriculture and the State agricultural colleges for advice and assistance in these matters. There was widespread recognition of the fact that in the cooperative extension system, with its combination of Federal and State administrative officers and subject-matter specialists, with county agents, farm bureaus, and other local organizations, a very effective means was provided for nation-wide dissemination of the needed facts, as well as practical demonstrations of the measures required to increase agricultural production along the best lines and to secure the most economical utilization of the products of the farms in the homes of the people. Congress responded to the widespread demand for the immediate expansion of the cooperative extension forces by taking up legislation to this end, but pending its discussion and passage the department and the States speeded up their work along these lines with such forces and funds as they were able to obtain and utilize. Thus the work of these agencies was profoundly affected and increased before the end of the fiscal year and the foundation laid for a much greater service now that larger resources have been put at their command. Much of the increased acreage and yield of important staple crops, the multitude of home gardens, the canning or otherwise preserving of perishable products, the modification of southern agricultural practice by increasing the production of foodstuffs without injury to cotton growing has been due to the efforts of these agricultural agencies prior to the end of the last fiscal year.

OFFICE OF THE DIRECTOR.

Problems connected with the organization and administration of the cooperative extension work continued to occupy to a large extent the attention of the director and other officers of the service during the second year of the operation of the States Relations Service. Much progress was made in the practical determination of the scope and limitations of the work and relationships under the Cooperative Extension Act of May 8, 1914, and related Federal and State legislation. Through correspondence and personal conferences with officers of the State agricultural colleges and representatives of the association of these colleges a more complete and satisfactory understanding of mutual privileges and obligations involved in the planning and conducting of cooperative enterprises under existing laws was arrived at.

Much attention was given to the development of relations with the other bureaus of the department by means of which satisfactory arrangements might be made with the State institutions for the extension work of these bureaus authorized by Congress. This often involved the establishment of practical lines of demarcation between extension enterprises and research or regulatory work. It also brought under consideration the broad problems of the relationships of the cooperative extension organization with organizations such as the State departments of agriculture and education, sanitary livestock boards, health services, etc.

The routine business of the office was increased greatly by the enlargement of the cooperative work and by the war emergency demands on the department.

EDITORIAL DIVISION.

W. H. BEAL, *Chief*.

All the publications of the service except Experiment Station Record were handled in an editorial capacity by this division as usual. The character of the work of the division was not modified materially during the year, but the number and volume of publications issued was increased. The service was called upon especially to meet a greatly increased demand for its publications bearing upon food conservation.

One hundred and nine documents, aggregating 4,845 pages, were issued by the service. These included 22 numbers of Experiment Station Record, 2 reports, 15 technical bulletins, 6 articles in the Journal of Agricultural Research, 13 insular stations publications, 1 Yearbook article, 5 Farmers' Bulletins, 11 illustrated lectures, 4 numbers of Agricultural Education Monthly, 7 numbers of Farm Demonstration Monthly, 21 documents relating to cooperative extension work in agriculture and home economics, and 2 administrative circulars. In addition to these formal documents, the service also issued (either in printed or in mimeographed form) a large number of informal documents, including leaflets of various kinds, blank forms, record books, and the like, required in connection with special features of the work of the service, and cooperated with the

Office of Information in the preparation of a considerable amount of press and other informational material of wider general interest.

A marked increase occurred also in the work connected with the collection and preparation of illustrative material for the use of employees or collaborators of the service. The collection of illustrative material was enlarged and improved, 3,184 photographs being added to the collection during the year, bringing the total number up to 6,794, of which 4,693 are mounted, classified, and catalogued for ready use. The number of lantern slides made during the year was 8,750, of which 2,045 are colored. About 1,151 shipments, aggregating 57,550 slides, were made to users of the slides within the service or to schools collaborating with the service. Facilities for securing new and better illustrative material especially suited to the work of the different divisions of the service were improved during the year. To improve these facilities further, a specialist in visual instruction and a lantern slide colorist, who will devote their whole time to the illustrative work of the service, were added at the close of the year.

INVESTIGATIONS ON AGRICULTURAL INSTRUCTION IN SCHOOLS.

C. H. LANE, *Chief Specialist in Agricultural Education.*

These investigations dealt as heretofore with studies of the methods and subject matter of instruction in agriculture, especially in secondary and elementary rural schools, with a view to improving such instruction and making it more practically useful.

While the increase in the number of secondary schools teaching agriculture has not been so marked as during the preceding year, there is every evidence that more effective work is being done. Out of 2,175 secondary schools reporting, 566 are teaching agriculture from a vocational standpoint. The standard of qualifications of the agricultural teacher has been raised materially and this appears to have had a large influence in increasing the proportion of men teaching agriculture in secondary schools. More than 1,000 teachers out of 2,254 have taken special training in agriculture, either a four-year agricultural-college course, short, or normal course.

Three hundred and ninety-two schools were using land for instructional purposes. The interest in school gardens has been noticeable. Three hundred and thirty-seven high schools are teaching the subject by the home-project method. Specific projects, with definite outlines and required reports, are used.

In addition to the effective teaching of agriculture through the school farm, and home projects, an unusual interest is being shown in laboratory and class observations on neighboring farms, and it is expected that this particular phase of agricultural instruction will receive greater impetus under the Smith-Hughes Act, passed February 23, 1917, which provides Federal aid for the purpose of cooperating with the States in paying the salaries of teachers, supervisors, or directors of agricultural subjects, and also for the preparation of these teachers, supervisors, and directors.

A detailed study of vocational agricultural instruction in high schools of the northeastern States was made in cooperation with the Bureau of Education. Through similar cooperation a survey was made of agricultural instruction in two counties of Texas.

Eight special agricultural schools, representing six typical southern States, were visited and their methods studied in detail. Special methods used in the training of teachers of secondary agriculture in six southern agricultural colleges were also studied.

Three conferences of workers interested in secondary agricultural education were held. At these conferences problems of supervision, relationships of boys' and girls' club work to agricultural instruction in the schools, and the reorganization of secondary courses in agriculture were discussed.

In cooperation with the Association of American Agricultural Colleges and Experiment Stations a study of the question of college credit for high school agriculture was made and the results published.

A report on secondary vocational agricultural instruction was prepared for the Commission on the Reorganization of Secondary Education of the National Education Association.

During the past year 14 brief pedagogical statements on how certain Farmers' Bulletins and professional papers issued by the department may be used in connection with the teaching of agriculture in rural schools were published.

After personal investigation and study manuscripts containing courses in agriculture for the rural schools of Vermont and Virginia were prepared for publication through the cooperation of the State agricultural college and State department of public instruction in the respective States.

Four numbers of the Agricultural Education Monthly were published, as were three numbers of a series of documents on secondary agricultural instruction, which superseded the Agricultural Education Monthly beginning with January.

A one-year general course in agriculture was prepared for the War Department.

Two sets of lantern slides dealing respectively with agricultural extension in secondary schools and the home project in teaching agriculture were prepared.

Demonstrations for the purpose of working out methods of teaching practical agriculture and problems connected with its supervision were made at the Eighth District Agricultural School at Manassas, Va.

The year's studies and observations show in general that much more systematic attention is being given to problems of agricultural education from a practical standpoint by many schools. Interest in the study of practical problems of agricultural instruction has been greatly promoted and the development of agricultural schools with practical aim and instruction materially aided.

INVESTIGATIONS ON FARMERS' INSTITUTES.

J. M. STEDMAN, *Farmers' Institute Specialist.*

In 17 States farmers' institutes are still conducted by the State departments of agriculture, the commissioners of agriculture, or a special State farmers' institute official, while in the remaining 31 States this activity has now been placed entirely in charge of the extension division of the State agricultural college, where it forms a

part of their regular extension work. In those States where the farmers' institutes are not under the management of the agricultural college there is a marked tendency to fit them into the extension movement by close cooperative arrangement with the college. The State farmers' institute activity, which formerly included institutes for young people, women's institutes, and movable schools, has now been largely restricted to the holding of the regular farmers' institute, the other activities having been provided for in the extension division of the agricultural colleges through their boys' and girls' club work, home economics work for the women, and various types of movable or extension schools.

Notwithstanding the recent rapid growth of demonstrations and other extension features, the attendance at farmers' institutes still maintains its maximum numbers. The reported attendance at farmers' institutes in 1916 was 2,947,679, with four States not heard from. There were 32,244 sessions, lasting 10,786 days, and the sum of \$370,420 was spent in the movement.

Farmers' institute directors and lecturers as well as county agricultural agents and other extension workers were all aided as heretofore, and information regarding farmers' institute work throughout the country was collected, tabulated, and published.

The various syllabi of lectures on agricultural topics, each accompanied by about 50 lantern slides, were in great demand. Several of the syllabi were revised or their accompanying sets of slides improved during the year. New syllabi were added as follows: Leguminous Forage Crops for the South; Leguminous Forage Crops for the North; Sweet Potatoes: Culture and Storage; The Farm Vegetable Garden; Practical Improvement of Farm Grounds; Public Road Improvement; and Cow Testing and Dairy Records. These lectures were used especially by farmers' institute workers, county agents, and other extension workers, as well as by teachers of agriculture in rural schools.

OFFICE OF EXPERIMENT STATIONS.

E. W. ALLEN, *Chief.*

The primary functions of the office consist in (1) the maintenance of the department's relations with the State agricultural experiment stations, including the supervision of the funds and the work under the Federal appropriations; (2) the preparation of the abstract journal Experiment Station Record, now in its twenty-eighth year, and of the card index of experiment station literature, both of which are designed to aid teachers and investigators in agriculture by furnishing a systematic record of the progress of agricultural investigation; and (3) the management of the Federal experiment stations in Alaska, Hawaii, Porto Rico, and Guam.

In addition to these main lines, the office has maintained an agricultural science register as a means of registering those desiring to enter station work and of assisting the experiment stations in recruiting their forces; and is keeping up its record of the organization and progress of experiment stations throughout the world. It is frequently called upon to look up the literature on special subjects for the experiment stations, and otherwise has served as a central agency for the advancement of agricultural investigation.

RELATIONS WITH THE STATE AGRICULTURAL EXPERIMENT STATIONS.

The relations between the office and the experiment stations in the several States have remained substantially the same as in preceding years. These relations are both supervisory and advisory. Under the Hatch and Adams Acts the office represents the department in its supervision of the funds granted by the Federal Government for agricultural experiment and investigation in the States, and deals with questions relating to the character of work conducted under these funds, the conditions provided for it, the relations of the station work to other activities of the institution, and other matters concerning the experiment station enterprise in each of the States. The aim in this supervision has been not merely to audit the accounts and see that the funds were used legally within the terms of the Hatch and Adams Acts, but to preserve the funds to the best use of the station, to stimulate investigation in the highest degree, and to secure conditions which will result in an increasing efficiency of the system of experiment stations as a source of new and tested knowledge.

Each of the experiment stations was visited and inspected during the year, the accounts examined, and the work of the individual members of the staff gone over. Conferences were held on various matters relating to the progress of the station, at which matters of general policy and the future development of the station were considered. These annual visits are welcomed by the directors of the stations, which fact illustrates the cordial relations maintained with these institutions.

The projects conducted under the Adams fund continued to receive careful scrutiny and constructive criticism. This applies not only to new projects which are submitted by the stations, but to the progress of projects which have been under way for a number of years and which frequently need strengthening or reshaping to make them progressive in the highest sense. As a whole, however, the projects under this fund, as well as those of the stations in general, are of increasingly high grade, more searching in character, and more competent to yield definite answers to specific agricultural problems.

An unusual number of changes occurred in the personnel of the experiment stations during the year, especially in the directorships. New directors were appointed in Georgia, South Carolina, and Utah. The director of the New York Cornell Station retired at the beginning of the year, the director of the Minnesota station at the close of the year, and the director of the Washington station a short time previous to the close of the year. The director of the Kentucky station died early in the year. Directors of these stations have not yet been appointed, their administration being placed in the hands of acting heads. These changes and other changes in the personnel of the staff have called for advice and counsel in filling the positions and in aiding the new appointees.

Considerable attention has been required during the year in the matter of adjustment of salaries between the station funds and other funds of the institution.

The year marked the close of a decade of operations under the Adams Act. The standards which that act set and which the office

has consistently attempted to maintain have had a remarkable influence on agricultural research and upon the development of the experiment stations. A clearer conception has grown up of the field and character of research as contrasted with other forms of experimental activity, and as a result of the exactions of a higher grade of work the qualification requirements for experiment station employees have steadily been raised. Men of superior training are sought where new positions are to be filled, and those already in the stations are stimulated to take advanced training. Some of the products and influence of the Adams Act, and the changes which have come with it, were presented editorially in the March issue of *Experiment Station Record* (Vol. XXXVI, No. 4).

The chief of the office continued to serve as a member of the committee on experiment station organization and policy of the Association of American Agricultural Colleges and Experiment Stations and devoted considerable study to the preparation of a report embodying suggestions for the improvement of experiment station publications. In general, marked improvement has been made in the character of the station publications and in their classification in accordance with the audience to which they are directed.

To a considerable extent the technical papers of the stations are being published in the *Journal of Agricultural Research*, issued by this department, on which the chief of the office serves as a member of the editorial committee.

EXPERIMENT STATION RECORD.

In accordance with the general plan in operation for several years, volumes 35 and 36 of *Experiment Station Record*, each consisting of nine numbers and the usual author and subject indexes, were prepared during the year. These volumes contained about 7,000 abstracts of the world's scientific literature pertaining to agriculture, together with monthly editorials discussing important phases of the development of agricultural investigation and science and brief notes on the progress of institutions for agricultural education and research in this country and abroad.

The total number of articles abstracted was smaller than for several years. This was due largely to the reduced output of most scientific institutions in Europe and to the ever-increasing difficulty in obtaining copies of many publications, especially those from Germany. On the other hand, the domestic literature continued to increase in both volume and importance.

INSULAR STATIONS.

The work of the Alaska, Hawaii, Porto Rico, and Guam stations continued along the usual lines during the early part of the year, but with the development of the food emergency brought about by the war many projects not immediately applicable to the situation were temporarily put aside and all efforts concentrated on increasing local production of food supplies, a work of primary importance, as whatever percentage of increase it has been possible to attain has reduced by that much the demand on the mainland. That this work was urgently needed may be realized from the fact that nearly

2,000,000 people of these sections were very largely dependent upon the mainland for food, the annual imports of such products into Hawaii and Porto Rico alone being valued at about \$20,000,000, in spite of the fact that many of the articles imported can be grown successfully in tropical countries. In their efforts to increase local production of foodstuffs the stations have cooperated with whatever agencies they found available, and so successfully has the work been carried on that imports in certain lines have been noticeably reduced. Already Porto Rico, which formerly imported more than \$800,000 worth of beans annually from the mainland, is in a position to export them. The Hawaii station, through cooperation with individuals and organizations of various kinds, greatly increased the local production of food crops. The Alaska stations greatly extended the areas sown to grains, so as to be able to meet increased demands for seed grain adapted to the country. The Guam station is distributing larger quantities of seeds and plants for cultivation by the natives, the results so far obtained having been satisfactory.

The only administrative change in the stations was the appointment of C. W. Edwards to take charge of the Guam station, in place of A. C. Hartenbower, who returned to his former home in the States. Mr. Edwards, a graduate of Michigan Agricultural College, with a number of years' experience in connection with the Philippine Bureau of Agriculture, entered upon the work in Guam early in the fiscal year. Those continuing in charge of the stations are: Alaska, C. C. Georgeson; Hawaii, J. M. Westgate; and Porto Rico, D. W. May; and to these gentlemen the successful planning and carrying on of the work at the several stations is largely due.

Acknowledgment is here made of the continued and cordial cooperation of the bureaus and divisions of the department and of the generous assistance they have given the stations.

The appropriations of the stations for 1917 were as follows: Alaska, \$48,000; Hawaii, \$40,000; Porto Rico, \$40,000; and Guam, \$15,000. These sums, together with small amounts remaining as balances from sales funds, represent the disbursements in connection with the several stations. The current-sales funds are no longer available to the stations for maintenance expenses, but are now deposited in the Treasury as miscellaneous receipts.

The administration and financial review of the affairs of these stations in connection with the States Relations Service continues under the direction of Walter H. Evans and the accounting office of the service.

ALASKA STATIONS.

One of the most important events connected with the Alaska stations was the provision by Congress for an experiment station in the Matanuska Valley, for which an immediately available appropriation of \$10,000 was granted. On the passage of this law steps were taken to begin operations in that region, a preliminary survey having already been made and a site for the station selected. The tract chosen, which embraces 240 acres situated about 2 miles from the town site of Matanuska, was set aside for use as an agricultural experiment station by Executive order dated September 20, 1915. Subsequently section 14 was added, and it is estimated that probably 150 acres of the two tracts can be readily cleared and cultivated. On

April 1, 1917, Mr. F. E. Rader, who had formerly been connected with the Alaska stations, was commissioned to proceed to Matanuska and begin the pioneer work of clearing the land and establishing the station. The clearing of land, erection of buildings, etc., are now well under way, and it is hoped that experimental work can soon be begun, as all the adjacent country for miles around has been homesteaded and the residents are looking to the station for instruction and assistance. The Alaska stations owe much to the Alaskan Engineering Commission for the successful inauguration of this station, and acknowledgment is most cordially made of the many favors received and assistance given.

The work at the Sitka, Fairbanks, Rampart, and Kodiak stations proceeded along about the same lines as formerly until the spring of 1917, when a special campaign for food production was begun. The season of 1916 was unfavorable to agriculture over much of the Territory. Fruit production and vegetable testing at Sitka gave less satisfactory results than usual. Five varieties of winter rye, one of winter wheat, four of spring wheat, six of oats, one of spring rye, and three of barley ripened in field plats at the Fairbanks station, producing about 600 bushels of grain. In addition, 1,200 pounds of turnip seed was produced for distribution throughout the Territory. In the spring of 1916 a cooperative experiment was entered into with a number of farmers in the Tanana Valley and adjacent regions for testing some of the station-grown grains, two varieties of oats and two of barley being thus distributed. The results, though not at all conclusive, are believed to have aroused an interest in grain growing in that region.

At Rampart the grain-breeding work continues to be a prominent feature, a considerable number of crosses having been made each year in the hope that early varieties of good quality and high yield might be secured. Several of these hybrids have been under observation for years, and though some exceed the parent plants in all the desired qualities they are still far from being fixed in character. Testing of varieties of grains is carried on, and increase plats are maintained to secure stocks of promising sorts. In the spring of 1917, 10 acres were seeded to various alfalfas, the seed for which had been grown at the station in 1916.

At the live-stock station on the island of Kodiak the herd was found to be infected with tuberculosis, 21 head out of 54 reacting. The animals showing the most pronounced infection were killed, and all others which reacted and several suspicious ones were transferred to Kalsin Bay, where an effort will be made to breed healthy cattle from them by following the method of hand-rearing calves on pasteurized milk. The sound animals are quartered at Kodiak. After the discovery of tuberculosis infection in the herd it was deemed necessary to remodel and practically rebuild the barns. Modern sanitary barns are needed for all the stations. The Holstein cattle bought in 1916 were landed at Kodiak, and the experiment of producing a cross having the hardiness of the Galloway and the milking qualities of the Holstein will be begun by making reciprocal crosses between these breeds.

With the development of the country the necessity of providing some means of popularizing the results of the stations' investigations is becoming apparent.

HAWAII STATION.

The work of the Hawaii station proceeded along the general lines previously described until the spring of 1917, when the station entered into an active campaign to bring about more adequate food production and conservation. In this work, the station cooperated with individuals and organizations of various kinds, and through the combined efforts of all agencies the supplies of locally grown foods have been largely increased.

The cooperative forage crop work at Schofield Barracks, begun in 1916, has been developed as rapidly as possible, about 50 forage and food crops being under test. Over 100 acres of land at this Army post has been cleared of brush, plowed, and planted to sweet potatoes and cassava this year.

The chemical work has been chiefly a continuation of investigations on the control of pineapple troubles due to abnormal soil conditions. The discovery, announced last year, that spraying pineapple plants with iron sulphate corrects the injurious effect of an excessive manganese content of the soil has been followed up, and more than 5,000 acres of pineapples was successfully sprayed during the year. Some preliminary experiments for the control of a pineapple wilt indicate that the application of lime to the soil will give relief. Work in progress on the drying of certain products has shown that by exposure in suitable containers cassava, sweet potatoes, taro, etc., can be readily dried in the sun and wind and the resulting product stored without apparent deterioration.

In the horticultural investigations special attention is given to pineapple breeding work, several thousand seedlings being grown for testing. Some introductions of improved varieties recently made are being tested in comparison with the standard variety grown in Hawaii. Similar work is in progress with mangoes, avocados, and other tropical fruits. The station has produced several thousand seedling tomatoes by crossing, and these are being given wide trial to determine their immunity to pests. A blight-resistant potato thought to be an accidental hybrid has been found which is being given a thorough test for immunity, the plants on the station plats appearing almost completely immune.

The agronomy investigations are confined to experiments with rice, taro, potatoes, leguminous crops, and forage grasses, much of the work being conducted in cooperation with the military authorities. Data already accumulated were of great value in the crop-production work of the 1917 season and will be available so long as the emergency continues.

The plant-disease investigations have been largely confined to work with potatoes, bananas, and celery, methods for the control of some of the most serious troubles having been determined. Through the extension division spraying campaigns have been conducted with marked success.

At the Glenwood substation, where the rainfall is heavy and the temperatures comparatively low, special problems are being investigated, the most profitable industry thus far developed for this region seeming to be poultry raising. Dairying is also given attention, and, with special methods of handling, some grasses and forage plants

have been found to succeed. The growing of celery for market purposes has been demonstrated as profitable if proper care is exercised in spraying the growing crop. The Glenwood substation is maintained in cooperation with Territorial authorities.

The Territorial marketing division reports a volume of business amounting to \$139,519.05 for the year, 474 individuals having consigned their produce to the division for sale. As the total sales for the first year (the division, which is largely supported by Territorial funds, was established and placed under the direction of the station July 1, 1913) amounted to only \$26,500, the increase shown for the past year is gratifying. The experimental features embodied in this enterprise having been largely worked out and the work of the division being now simply a commercial undertaking, its relations with the station were terminated June 30, 1917, and it will continue to be operated solely under Territorial authority.

The extension work of the station, now being developed as rapidly as possible, receives a manifest approval which is very gratifying. It is impossible to reach all localities and nationalities with the present resources, but through cooperators, demonstration farms, and personal visits of the superintendent of extension and his collaborators the advantages of diversified agriculture are being given wide publicity. The local papers and a series of emergency publications are also used to spread information. The station had a large share in a movement to start school gardens and boys' and girls' clubs, which were conducted for the first time in the islands during the past year.

PORTO RICO STATION.

With the increased appropriation granted the Porto Rico station the extension work was greatly developed, and it is now being very successfully carried on throughout the island. In connection with this work cooperative demonstration experiments were started in many sections of Porto Rico not hitherto reached. These give opportunity for testing new crops and new varieties introduced through the station. Particular attention has been paid to the testing of such food crops as cowpeas, soy beans, peanuts, and beans, and of forage plants, among them velvet beans, sorghums, Sudan grass, Napier grass, etc., active interest in the production of these crops having been so aroused that all are being extensively planted. Cowpeas, which have been found adapted to some of the poorer lands, are becoming an important factor in feeding the people of Porto Rico. On bare lands cowpeas and soy beans are the best crops for immediate results. These may be followed by kafir, sorghum, and Sudan grass with excellent effect, not only in returns from these crops, but in bringing the land under permanent culture and in preventing further erosion of the soil. Some 200 acres of hill land, denuded of forests, has been put under experiment by the station to see if such areas can be profitably reclaimed.

The station has entered upon an active campaign to improve the economic plants of the island through the introduction of new crops and through plant breeding by selection and crossing. Such work, it is believed, will noticeably improve Porto Rican agriculture.

As many of the soils of the island lack fertility the chemists of the station have given special attention to soil investigations, par-

ticularly with a view to determining the relative efficiency of various fertilizing constituents. A survey of the guano deposits of the island was completed. Some work which has been begun to find the efficiency of nitrate of soda and sulphate of ammonia for rice is of importance in view of the possibilities of rice growing in the island. Further biochemical investigations of chlorosis of plants are in progress. Comparative tests of nitrate of soda and sulphate of ammonia for pineapples have given some striking results, but the experiments are to be repeated before conclusions are drawn regarding them.

The experiments with fertilizers for coconuts, which have been in progress for several years, seem to indicate that yields may be largely increased by the use of complete fertilizers, but there has thus far been no increase in the size of the individual nuts. The work with coffee and cacao has been continued and data regarding the crop obtained. Leguminous shade trees have been successfully introduced, which so far have not been so subject to fungus and insect pests as the species commonly employed in shading coffee and cacao. The station's work with vanilla has been so successful that it appears that vanilla growing can be made a profitable industry. Arrangements have been perfected for making several commercial plantings of vanilla under the supervision of the station, and these, it is hoped, will serve as demonstrations.

The entomologist and the pathologist are continuing their investigations of crop pests. Special investigations on the insects affecting stored grains are in progress, and information regarding precautions to be observed has been prepared and issued. Among the plant diseases receiving attention are the banana wilt, citrus scab, bean rust, tomato and potato blight, etc. Methods for their control are being worked out.

Following the station's work with forage crops and the introduction of improved breeding animals, the live-stock industry of the island is making satisfactory progress. Extensive plantings of kafir corn, Sudan grass, Napier grass, etc., which were introduced by the station, are to be found in many parts of Porto Rico, and these crops, as well as cane tops and velvet beans, have been successfully made into silage. As a result, the cattle industry is thriving and dairying has been widely extended, a great improvement in sanitary conditions involved in the production and marketing of milk having resulted from the station's demonstrations in handling this product.

GUAM STATION.

The animal-husbandry work of the station has been confined to increasing and improving the station herds by the use of pure-bred sires, producing improved sires for public use, finding the best methods for taking care of different classes of live stock, and adapting pure-bred and grade animals to local conditions. The number of horses was increased by the birth of one male colt during the past year. No attempt will be made to enlarge the stud, as the station now has as many head of breeding stock as its resources will maintain. Several head of grade Ayrshire cattle were added to the herd by births during the year, there being no losses. Three half-breed Ayrshire-native bulls have been maintained in different localities for free public service. Two of these half-breed bulls, pastured on native

range and receiving no especial attention, are in good condition, an indication of the hardiness of the cross. Feeding experiments are in progress with both horses and cattle to test the value of locally produced forage, and though these experiments have not been carried on long enough for generalizations, they indicate that Para grass is an excellent feed for maintenance and that coconut meal may be substituted for at least one-half the grain feed. The swine herd consists of two Berkshire boars, several half-breed Berkshire-native brood sows, and a number of three-quarter-breed pigs. Some grade animals have been sold to the public for breeding purposes. Grazing experiments have shown the value of Para pastures for growing pigs. In an attempt to find the value of breadfruit and coconuts when fed to pigs, the results showed lower gains, even when these foods were fed in combination with grain than when grain was fed alone. During the past year satisfactory results have been obtained with poultry, the principal problems considered being breeding and feeding. A considerable number of eggs for settings and chicks for breeding purposes have been sold to the public.

The work in agronomy has been continued along the usual lines, especial emphasis being placed on forage and cover-crop production. Para grass and *Paspalum dilatatum* are proving more valuable every year. Sudan grass, which was introduced last year, gives promise of being an excellent soiling crop for Guam. Kafir and amber cane have yielded well both as to forage and grain. The improvement of native corn by selection and ear-to-row planting is being continued, increased yields having already been obtained. Egyptian and improved upland cotton are still under test, with yields last year of from 823.4 to 921.8 pounds of seed cotton per acre for Egyptian and 787.6 to 974.4 pounds for upland.

In the horticultural work, distribution of seeds and plants continued to be an important feature, the demand among native farmers for plant materials having largely increased during the past year. Arrangements have been made with the insular police for reports on the different plantings. Experiments are in progress to determine the best time for planting all the important garden crops. Variety tests are being conducted, while the questions of source of seed and kind, quantity, and time of application of fertilizers are receiving attention. Investigations have been begun looking to the improvement of the cultivation of coconuts, bananas, papayas, and other important tropical crops. A considerable number of plant introductions which have been propagated will be ready for cooperative distribution at the beginning of the present rainy season.

VIRGIN ISLANDS.

At the urgent request of the Secretary of the Navy, D. W. May, agronomist in charge of the agricultural experiment station in Porto Rico, was detailed to visit the Virgin Islands of the United States and report on the agricultural situation, with suggestions regarding the steps necessary to make the islands more nearly self-supporting. Mr. May has had an experience of more than 13 years in Porto Rico, which lies near the Virgin Islands, and his suggestions should prove of value if put into practice.

The only crops found cultivated to any extent were sugar cane and Sea Island cotton, the yields of which are low compared with other West Indian islands. There is an almost complete absence of fruits and vegetables in the markets, indicating very limited supplies of locally produced food materials. Stock growing is followed to some extent, but improved stock is needed, better forage plants should be introduced, and more attention given to the proper handling of stock, dairying, etc.

An experiment station, under Danish authority, was located on St. Croix in 1912, but its work has been very largely with sugar cane. This institution has been locally supported, but there has been a lack of cooperation between the station and the people. This station should be adequately supported and its work extended to include other possible industries and provision made for presenting the results of its investigation to the people of the other islands of the group through extension and demonstration campaigns.

OFFICE OF EXTENSION WORK IN THE SOUTH.

BRADFORD KNAPP, *Chief.*

J. A. EVANS, *Assistant Chief.*

The cooperative agricultural extension work as now organized in the 15 Southern States is carried on along the following lines:

1. Administrative work in carrying out the provisions of the cooperative agricultural extension act of May 8, 1914.
2. Extension demonstration work through county agents.
3. Extension home-demonstration and girls' club work through women county agents.
4. Extension demonstration work through boys' clubs.
5. Extension demonstration work of specialists through county and women agents.
6. Extension demonstration work for negroes, including boys' and girls' clubs for negroes.
7. Extension work through special agricultural campaigns.

The work along these lines is carried on in cooperation with other bureaus of the department, the State agricultural colleges, the counties, and State and local organizations.

ADMINISTRATION.

The administration of the Office of Extension Work in the South is in charge of a chief and one assistant chief. They are assisted by four field agents in the administration of county agent and all cooperative extension work in the States; three men and four women in the administration of home-demonstration and boys' and girls' club work; and the necessary office assistants and clerical force. There are also six joint representatives of the Office of Extension Work in the South and other offices or bureaus of the department who assist in the supervision of the work of the cooperating specialists in the various States.

Visits were made to each of the State agricultural colleges to inquire into the work under the approved Smith-Lever project agree-

ments. Full reports on the condition of the work and the results obtained in each of the 15 States were prepared.

Representatives of the office attended and assisted in conducting the annual and semiannual meetings of county agents, home demonstration agents, and other extension workers in each State. The chief or one of his assistants attended and addressed many other meetings of importance to the development of agriculture and home economics in the South during the year. The office assistants made special trips into all the States to advise with the extension force and to visit field demonstrations with the agents.

A large number of circulars were prepared and distributed for the purpose of emphasizing the need of a greater production of food and feedstuffs in the South and the necessity of conserving the surplus by canning, drying, and storage.

COUNTY AGENTS.

That the county-agent plan of carrying on agricultural extension work is a firmly established and satisfactory system in the 15 Southern States is shown by the fact that the legislatures of most of the States are making liberal appropriations to aid in its support. Progress was made in the general plan of placing an agent in every county in the States. More or less difficulty is being experienced in all of the States in obtaining a sufficient number of well-trained men and women with practical experience for agents. The employment of young men graduates of agricultural colleges as assistant county agents as a means of giving them training and experience is being tried in several of the States, with promising results.

ORGANIZATION.—The progress in the organization of the county agents' work in the South was gratifying. County agents received instructions in the organization of their work, especially the organization of community clubs to receive instruction from demonstrations and otherwise. The last annual report showed the formation of 1,654 community organizations of farmers, with a membership of 44,548 farmers; the report for the present year shows 2,508, with a membership of 78,660. This record does not take into account any cooperating organization not organized by the county agents, but, nevertheless, giving active support and assistance to the county agent and thus serving in the capacity of a local community organization. These include organizations in existence before the county agent came—local granges, farmers' unions, and church and civic organizations of various characters. It is estimated that about 200,000 farmers are enrolled in the various community organizations which are assisting the county agents. An added impetus was given to organizations of this character by the war. (For reference to organization of women's clubs, see p. 19.)

PLAN OF WORK.—In the work in the South the county agent is recognized as the leader in all of the agricultural extension activities in his county. In many of the States a written plan of work for the year is prepared by the county agent, subject to the approval of the cooperative extension authorities. This includes a program of demonstrations, both personal and community; special campaigns; movable schools; organization work; community organization of

boys' and girls' club work; and special demonstrations conducted with the assistance of specialists, and other features of the work, and makes such plan of work a basis for recording progress during the year. Boys'-club work is an important feature of each county agent's activity. Demonstrations by specialists are planned and outlined at the college and placed in the hands of the county agents, who, with the assistance of the specialists, take up such special demonstrations as a part of their regular plan of work.

There were employed in the 15 Southern States during the year 860 regular county agents, 28 assistant county agents, 513 women agents, 31 boys'-club agents, and 66 colored men agents, and 7 colored women agents for work among colored people. Each State has also a director of extension and a State agent or assistant director in charge of the work of the county agents. There are 646 women engaged in the home-demonstration work. Of these, 13 are State agents in charge of the work in their respective States, 48 are assistants and district agents, and 572 county women agents, and 13 colored home-demonstration agents.

RESULTS.—In the season of 1916-17 approximately 120,000 adult farmers conducted demonstrations in one or more lines of farm work at the suggestion and under the supervision of county agents. Probably ten times that many farmers were directly influenced to practice better methods of agriculture as a result of these demonstrations. At the field meetings or schools held in a demonstration field it is the practice to invite the neighboring farmers to take part in the discussions, and thus to extend the agents' influence.

During the season of 1916 demonstrations were conducted as follows: Corn, 543,889 acres; cotton, 333,615 acres; tobacco, 3,588 acres; small grains, such as wheat, rye, oats, barley, etc., 282,074 acres; various hay, forage, and cover crops, 271,269 acres; summer legumes planted for hay, seed, soil improvement, and other purposes, 474,479 acres; potatoes, 15,193 acres; and old pastures renovated, 149,239 acres.

The extent and variety of advice and assistance the county agent is called upon to give is indicated by the following data taken from the county agents' reports: Through the influence of county agents farmers were induced to remove stumps from 179,382 acres to better prepare the land for the use of improved implements; 218,989 acres were drained by tile and ditch and 463,856 acres were terraced; home gardens were established or improved on 26,754 farms; the number of pieces of improved farm machinery and implements purchased through the influence of county agents was 81,389; and orchard work of many kinds was done, including spraying, pruning, and other necessary treatment, the demonstrations in this work involving 544,658 trees.

Considerable attention was given to promoting live-stock production, 4,367 new silos having been constructed to aid in this work and 2,829 dipping vats erected for the control of live-stock pests. There were 45,154 farmers instructed concerning the proper care of farm manure, with an estimated saving during the season of approximately 10,000,000 tons. It being found necessary to supplement the use of farm manures and green crops for soil-improvement purposes with commercial fertilizers, 127,131 farmers were instructed in the mixing

and use of the commercial product, and 1,11. communities were aided by county agents in purchasing commercial fertilizers on a cooperative basis, resulting in an estimated saving of \$290,766.88.

In addition to the benefits accruing from the greatly increased yields on demonstration acreage, many thousands of farmers were conclusively shown how to increase their producing power and place their farms on a business basis. As a result their plans of operation are better balanced than before; they understand the necessity for rotations and the maintenance of soil fertility and what an important part live stock plays in their plans; and they have had demonstrated to them the increased value of pure-bred cattle, hogs, and other live stock. The growth in sentiment along these lines is indicated by the following figures, showing the live stock brought into county-agent territory through the influence of the agent: Pure-bred horses and mules, 3,202; pure-bred and high-grade dairy cattle, 22,299; pure-bred and high-grade beef cattle, 32,709; pure-bred hogs, 29,636; pure-bred sheep and goats, 17,554. Poultry demonstrations involving an aggregate number of 163,330 were conducted. Live-stock diseases and pests received increased attention, 2,488,426 horses, cattle, hogs, sheep, and goats having been treated during the last season.

County agents made 809,714 visits during the year, traveling 3,590,567 miles by rail, team, auto, and otherwise. During the season the county agents received 373,015 official telephone or personal calls at their homes or offices. They held 11,708 field meetings, attended by 132,355 people. There were distributed 840,635 bulletins of the department and of the State agricultural colleges and experiment stations. The county agent, being looked upon as a local leader, is very frequently called upon to assist in arranging and holding agricultural meetings. During the last season county agents assisted in the holding of 837 extension schools, or short courses, with an attendance of 130,761.

HOME-DEMONSTRATION AND CANNING-CLUB WORK.

This work continued in charge of O. B. Martin and Miss Mary E. Creswell.

In 1916, 419 counties were organized in the Southern States under women county agents, who enrolled and instructed 37,964 girls in canning clubs, 9,656 girls in poultry clubs, 22,048 women as home demonstrators, and 2,211 women in poultry clubs. During the year 1916-17 there was a notable development in demonstrations by women in productive activities, such as poultry raising, home butter-making, gardening, and canning. Many women, under the supervision of county agents, also carried on extensive work in cooking, making labor-saving devices, and planning improved arrangement of equipment and furniture with reference to more efficient housekeeping. During the previous year the most notable development in women's work was the rapid increase of the number of women who undertook for extended periods to carry on demonstrations in their homes.

A logical development in 1916 was the organization of many more community clubs among rural women. In 1915 about 250 such clubs were organized; in 1916, 1,042. These clubs held a total of 27,260

meetings, with an attendance of 476,366. Thirty-seven egg circles, producing poultry products worth \$53,952.76, have been organized by the women and girls.

War conditions and needs have brought about a great extension of activities along the general lines which the home-demonstration work has pursued for the last seven years. For example, the very earnest campaigns of the past year for a home garden on every farm were simply a part of a "safe farming" program which has been advocated for several years. These campaigns have been extended to the cities, towns, and villages as well, and it may be safely said that the number of gardens has increased during the past season by two to three hundred per cent. The great increase in gardening naturally increases the interest in the preparation of vegetables for the table, and especially in canning, drying, pickling, and brining of fruits and vegetables for future use. Early in the season circulars on home drying, pickling, and brining were prepared and circulated, and all of the home-demonstration agents were given special instructions in these methods. The work was enormously enlarged by the demands of village, town, and city residents for instructions along these lines. A large number of volunteer workers assisted in spreading the information and in giving demonstrations for the benefit of their neighbors.

WOMEN'S CLUBS.—In the regular process of the organization of the work itself more than 1,000 community clubs of rural women were organized as mentioned above, but under war pressure federations of women's clubs and various civic and church organizations of women have also greatly assisted in the work.

On July 1, 1917, 1,615,880 women and girls were enrolled for definite demonstration work in food production and conservation. This does not include the number of women volunteers giving instructions to their neighbors under various schemes of organization. In one State alone 200,000 women undertook to carry out without compensation some lines of food conservation in their own neighborhoods under the instruction of home-demonstration agents.

A few years ago canning was done by a relatively small percentage of the people in the South. Now canning is a general practice in many parts of that region, and reports from most of the States indicate that the amount of fruits and vegetables preserved for future use by canning, drying, pickling, and other means is from four to five times as great this year as during any previous year.

Early in the spring of 1917 the price of tin cans increased to such an extent as practically to prohibit their use by the individual canner. Through the cooperation of the Bureau of Chemistry, the Council of National Defense, railroads, and manufacturers of tin cans, the office was able to perfect an arrangement by which more than 10,000,000 cans were shipped in car-load lots from certain factories direct to counties in the South and sold at cost plus the freight and handling. The net saving to Southern women and girls through this activity alone is estimated at more than a quarter of a million dollars.

Home improvements or devices were made or installed under the leadership of the women agents as follows: Fireless cookers, 3,290; iceless refrigerators, 2,171; flytraps, 5,025; kitchen cabinets, 180; floor mops, 119; wheel trays, 292; ironing boards, 486; water systems,

361; shower baths, 57; houses screened, 1,270; miscellaneous articles made, 4,032; rest rooms established, 101; butter paddles, 635; butter molds, 624; thermometers, 241; shotgun cans, 214; barrel churns, 180; butter workers, 79; number pounds butter made under demonstration methods, 92,649. The number of girls reporting in canning-club work was 21,172. Of these 7,058 made demonstrations in cooking-club products, and 11,384 made bread demonstrations. There are reported to date 623 State and county scholarships won as prizes by club girls. These club girls made 23,767 caps and aprons, 3,875 uniform dresses, 2,341 towels, 1,776 holders for use in demonstrations, and 400 miscellaneous articles of sewing. The total number of containers of fruits and vegetables packed by the women and girls under demonstration methods was 5,144,747, with a total value of \$956,669.67. The total number of winter-garden demonstrations by the girls and women was 7,649.

The enrollment of demonstrators July 1, 1917, included 51,075 girls in canning clubs, 13,466 girls in poultry clubs, and 35,506 women. The number of counties had increased to 518, and the total number of agents was 556. In the annual meetings early in 1917 these agents were given special training in the phases of food conservation demanded by conditions of this season, including drying, brining, and storing of vegetables, and making of bread with partial wheat-flour substitutes. The planting of additional areas of peanuts and soy beans for use in bread making was made a part of the campaign for increased food production. Following the instructions given by department and college specialists to county home demonstration agents in annual meetings, the weekly reports of these agents show that in the month of May, 1917, these special lines of information were given to 237,307 people in 6,083 meetings, and in addition 24,801 personal conferences were held. In the preservation of perishable foods the most notable development was the widespread use of drying to supplement canning in saving fruits and vegetables.

EXTENSION WORK THROUGH BOYS' AGRICULTURAL CLUBS.

Boys' agricultural club work, in charge of O. B. Martin and I. W. Hill, was carried on by State, district, and county agents cooperating with school officials and business men. The number of boys enrolled in 1916 was 75,605, classified by clubs as follows: Corn, 37,312; peanut, 1,938; potato, 1,202; grain sorghum, 2,079; cotton, 3,134; 4-crop, 1,457; miscellaneous farm-crop clubs, 2,341; pig, 23,167; calf, 974; poultry, 2,001.

The enrollment greatly increased in 1917 and now approximates 100,000 in the regular clubs. In addition to the regular enrollment approximately 20,000 were enrolled to assist in meeting the emergencies incident to the war. A large number of members have already been enrolled in wheat clubs for 1918, wheat, rye, and oat clubs being organized wherever the growing of these crops is thought to be practicable.

The average corn club yields in Alabama, Arkansas, Georgia, Mississippi, Oklahoma, South Carolina, and West Virginia were less than the average obtained for the three years preceding due to unfavorable weather conditions. The average yield throughout the territory was 44.4 bushels. There were 146 boys who made over

100 bushels of corn per acre. Some good records were made in other farm-crop clubs.

Farm makers' clubs for negro children were organized during the year in several States. Much work has been done every year in these clubs among negroes, but it was systematized as a separate project in 1916. The average yield of corn made by these clubs throughout the territory was 35.9 bushels.

Pig clubs, promoted in cooperation with the Animal Husbandry Division of the Bureau of Animal Industry, are very popular. Thousands of pure-bred pigs have been distributed among the boys, with excellent results. The boys' pig clubs have made well-bred pigs common in places in the South, where formerly a well-bred hog was scarcely known. The costs per pound of gain varied from 3.6 cents in Georgia to 6 cents in Oklahoma. Reports show that the average profit made by members where grazing crops were used was \$22.18, and where grazing crops were not used, \$11.25.

The use of club work as a home project for school work by teachers in public schools increased during the year. In some States credits for graduation are now being given for agricultural-club work. Community clubs are being organized throughout the territory under local leadership. Approximately 2,500 of these clubs were organized during the year. Short practical courses in agriculture for club members have been provided in nearly all the States. The boys attending these courses are usually prize winners and have their expenses paid while attending the camps or schools. Many boys have been inspired by the work to continue their studies in the agricultural colleges. There are a number of county agents who received their first training in agriculture in these clubs.

SPECIALISTS.

In addition to the county agents a considerable force of specialists in different branches of agriculture and home economics from State agricultural colleges and department bureaus are engaged in extension work.

The importance of these specialists in the accepted plan of cooperative agricultural extension work under the Smith-Lever Act is being appreciated more and more as the work grows and develops. As a larger number of people avail themselves of the services of the county agents to help solve difficult farm problems the county agents depend more on the specialists for expert advice and assistance. The specialists assist the county agents in farmers' meetings, county short courses, special campaigns, etc., and especially with difficult problems that call for special scientific knowledge. Each specialist plans, in cooperation with the county agents, to carry on a number of demonstrations to bring about the adoption of farm practices that the experiment stations and other reliable sources of information have proved to be the best. These demonstrations are made a definite part of the county agents' work. In most of the Southern States the itineraries of the specialists and the county agents are arranged to the best advantage of both. The county agents usually arrange the preliminaries for meetings and demonstrations at which the specialist presents the problem requiring his special technical knowledge.

Very cordial relations exist between the specialists and the county agents in most of the States.

There are now employed specialists in marketing and rural organization, dairying, live stock, animal disease, plant disease, horticulture, entomology, agronomy, agricultural engineering, home canning, curing of meats, farm management, etc. At the close of the fiscal year 1916 there were 201 specialists in the 15 Southern States.

NEGRO WORK.

All the States except Tennessee have one or more negro demonstration agents for work among the negroes. There were on June 30, 1917, 66 negro men agents and 7 negro women agents carrying on work in thickly settled negro communities along practically the same lines as among white people.

In most States the special work for negroes is carried on by co-operation between the department, the State agricultural colleges for whites, and the negro agricultural and industrial colleges. The cooperative arrangement within the State is perfected by the college for white people receiving the benefits of the Smith-Lever Act.

In most cases the negro agent is an assistant to the regular white county agent to conduct the work among the negro people of the county. Under this plan the regular county agent has general supervision of the work. In the negro boys' clubs, called farm makers' clubs, and negro girls' clubs, called home makers' clubs, to distinguish them from white boys' and girls' clubs, there were enrolled at the close of the fiscal year 1916 75,605 negro boys and girls, an increase of nearly 17 per cent over the previous year. Incomplete reports for 1917 indicate that the growth of the work for negroes was probably as great during the last year as in 1916.

SPECIAL CAMPAIGNS.

The agricultural situation in the South, especially in the cotton belt, during the last three years has been one of extremes. When the war broke out in 1914, cotton went down to 5 and 6 cents a pound. Through the "safe farming" campaign described in the last annual report there was a large increase in food crops and a 15 per cent reduction of acreage in cotton in the season of 1915. In the fall of 1915 the price of cotton advanced. The efforts of the extension forces in all the cotton States were redoubled to maintain or increase the food acreage. In the season of 1916 there was an increase of 15 per cent in the cotton acreage, but no material reduction in the acreage of food and feed crops over the 1915 increase.

The spring season of 1917 was not advantageous for the planting of crops. Nevertheless the net result of the intensive campaign conducted by the demonstration forces to increase the product of food-stuffs was a remarkable increase in the planting of corn, soy beans, velvet beans, cowpeas, peanuts, sweet potatoes, Irish potatoes, and other food and feed crops. The acreage increase of corn in the South during 1917 was from 10 to as high as 20 per cent, while the production in some States was nearly 100 per cent over the production of 1916. Mississippi, Alabama, Georgia, Florida, and South Carolina

greatly increased the planting of velvet beans. The increase in these States alone is estimated at 1,500,000 to 3,000,000 acres. Peanut acreage is estimated to have been increased from 1,245,000 in 1916 to 2,000,000 in 1917.

Besides this, special campaigns with reference to animal-industry work were carried on through cooperation of State and Federal specialists with the county agents.

LIVE STOCK.—Special efforts were made by extension workers in all the Southern States to encourage the production of more and better live stock. The county agents and State and Federal animal-industry specialists, assisted by bankers and other business men, did everything possible to aid farmers to obtain breeding stock of all kinds and assisted with plans to produce the necessary feed crops and pastures for their profitable maintenance.

DAIRY WORK.—Extension workers made special efforts to increase the production of dairy products. Cow-testing associations and bull associations were organized; farmers were assisted in obtaining pure-bred dairy cattle and instructed in the most profitable methods of producing milk, cream, butter, and in some localities cheese; silo construction was encouraged as a means of preserving feed for dairy cattle.

HOG CHOLERA.—The county agents, cooperating with the State and Federal hog-cholera specialists, were very successful in reducing losses usually suffered from hog cholera. Statistics of the number of hogs treated and the amount of sanitary control work done are not available at this time, but it is evident that the disease was kept under control better than heretofore and the losses greatly reduced by reason of the active campaign for hog-cholera eradication.

TICK ERADICATION.—Extension workers assisted actively in the campaign of education for the eradication of the cattle tick. Special progress was made in the States of Mississippi and Arkansas, laws being passed requiring the people to kill the ticks.

OFFICE OF EXTENSION WORK IN THE NORTH AND WEST.

C. B. SMITH, *Chief.*

L. A. CLINTON, *Assistant Chief.*

The general administrative work of the Office of Extension Work in the North and West has been continued essentially as outlined in the report for 1916. Cooperative relations have continued with all the 33 States of the North and West, the work of the office being organized as follows:

1. Cooperative relationships and projects.
2. County agricultural agents.
3. Boys' and girls' club work.
4. Farm-management demonstrations.
5. Extension work with farm women.
6. Extension specialists.

The office is charged with the administration of the provisions of the cooperative extension act of 1914, in so far as they apply to the 33 Northern and Western States, including the preparation of re-

ports for the information of Congress, and with the work of coordinating and unifying the extension work conducted by the several bureaus and offices of the department. In the furtherance of the administrative work conferences are held with State extension directors and members of their staffs, as well as with the many extension directors and other interested workers who visit the Washington office. Through these conferences many adjustments in relationships are made; the various State and department workers come into a better understanding of cooperative agricultural extension purposes and methods and are enabled to work in more effective partnership. The details of the work as handled by the various administrative sections of the office are set forth as follows:

COOPERATIVE RELATIONSHIPS AND PROJECTS.

This section, in charge of L. A. Clinton, has immediate responsibility for correlating the extension work of the department with that of the State colleges of agriculture of the following-named States: Arizona, California, Colorado, Connecticut, Delaware, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, Wisconsin, and Wyoming.

This section also cooperates with the State extension directors in the preparation of plans for work; inspects the work in the field to study methods in use and to determine their effectiveness; makes annual examinations of vouchers and accounts arising under the act of Congress of May 8, 1914; examines the reports submitted by the State extension directors to learn whether the work and expenditures have been in accordance with approved projects; and prepares reports to show the receipts and expenditures of the several States for extension activities and the results of extension work.

During the year each of the 33 Northern and Western States was visited; a financial report was received from each of them on forms approved by the Secretary of Agriculture; and, on the basis of these and other reports from the State extension directors and the reports of personal visits made, a report was made to the director of the service, to be used in the preparation of the annual report of the Secretary to Congress.

Project agreements have been prepared concerning nearly all departments of extension work in agriculture and home economics conducted by the several State agricultural colleges. Similar agreements have been prepared to coordinate the extension activities within the department, thus bringing the several bureaus into effective working relations with State extension agencies. From the 33 States more than 300 projects, or plans for work, were submitted for consideration and approval; and from within the department itself about 50 projects were submitted.

COUNTY AGRICULTURAL AGENTS.

The county-agent work was continued as last year with W. A. Lloyd in immediate charge. The number of county agents cooperatively employed during the year increased from 414 on June 30,

1916, to 544 on June 30, 1917. Nevada appointed two agents during the year, and each of the 33 Northern and Western States now has instituted county-agent work. In three States—Connecticut, Delaware, and New Hampshire—an agent has been appointed for each county. The supervision of the work of the agents by the State extension directors, county-agent leaders, and assistant county-agent leaders has been made more effective. Ten assistant county-agent leaders were added during the year.

WORK IN RELATION TO CROPS.

CORN.—The work of the agents in connection with corn consisted mainly of testing seed corn, fall selection of seed corn, the introduction of improved varieties of corn, including silage corn, and the use of fertilizers. One thousand one hundred and ten demonstrations, involving 48,209 acres, were conducted by county agents in the various States in which records were kept, showing the increased yield and the increased net profit per acre. The average increase in yield was 15.5 bushels per acre, and the average increased profit per acre was \$5.56. A total of 27,635 farmers selected their seed corn in the fall, and 416,066 acres were planted with fall-selected seed. Twenty-eight thousand three hundred and one farmers tested their seed corn, planting 785,666 acres with the tested seed.

WHEAT.—The wheat work of the county agents related largely to the introduction of improved varieties, the use of commercial fertilizers, and the sowing of wheat after the fly-free date to prevent the ravages of the Hessian fly. Ten thousand five hundred and five acres were involved in demonstrations, giving an average increase in yield per acre of 8.1 bushels. The average increased net profit per acre was \$8.11. Nine thousand and ninety-seven farmers grew wheat under the direction of the agents, sowing 287,032 acres.

OATS.—The principal work with oats was the treatment of seed oats for the prevention of smut. Four thousand six hundred and sixty-one demonstrations, involving 380,385 acres, on which checks were left and records were kept of cost and increased yields, were conducted. These gave an average increased yield of 4.3 bushels per acre and an average net profit per acre of \$2.98, with a total net profit of \$1,137,209.25. Fifty-three thousand one hundred and thirty-three farmers treated their seed oats, sowing 1,281,118.5 acres. Work was also done to introduce improved varieties to increase the use of fertilizers and improved cultural methods. The average increase in yield per acre on 158 such demonstrations, involving 1,530 acres where records were kept, was 14.7 bushels, with an increased average net profit per acre of \$7.79.

LEGUMES.—The county agents laid special emphasis on the growing of more legumes. Their work was largely that of introducing legumes suited to soil and types of farming. Fifty thousand six hundred and five acres of alfalfa, 24,825 acres of sweet clover, 21,480 acres of soy beans, 16,485 acres of cowpeas, and 14,607 acres of winter or hairy vetch were grown under the direction or at the suggestion of the county agents.

POTATOES.—Treatment of seed to prevent disease, seed selection, and standardization of varieties were the main lines of work of the

county agents with potatoes. Eight thousand one hundred and sixty-six farmers treated their seed potatoes to prevent disease, planting 30,226 acres. The agents conducted 418 demonstrations, involving 5,129 acres, to show the value of seed treatment. The average increased yield secured per acre was 25.4 bushels, and the average net profit per acre was \$12.45. The average increased yield secured on all demonstrations where records were kept was 39.7 bushels per acre. A total of 34,314 acres was grown under the agents' direction or at their suggestion.

ORCHARDS.—Much work was done by county agents in stimulating pruning and spraying and otherwise caring for orchards. A total of 5,640 orchards, involving 1,152,930 trees, were cared for under the direction or on the advice of the agents.

WORK IN RELATION TO LIVE STOCK.

LIVE-STOCK DISEASES.—To demonstrate the value of methods of eradicating diseases special emphasis was placed by the county agents on educational demonstrations involving relief methods in dealing with live-stock diseases, especially hog cholera, blackleg, and tuberculosis. Records of the losses and the cost of the treatment were kept in 325 demonstrations in hog cholera involving 10,527 hogs. The saving effected was \$92,547.23, or \$8.79 per hog vaccinated. Two hundred and ten thousand two hundred and ninety-seven hogs were vaccinated by the county agents or by veterinarians and farmers at the suggestion of the agents. One hundred and thirty-four hog-cholera control clubs were organized by the agents. One hundred and twenty-one thousand and seventy-one cattle were treated for blackleg, and 17,735 were tested for tuberculosis by the agents or on their suggestion. The agents organized special campaigns for better sanitary conditions about farmsteads.

STOCK IMPROVEMENT.—Much work was done, as in previous years, by the agents to improve the quality of the live stock and to standardize it by communities by the introduction of registered sires and by the formation of breeders' associations. There were procured on the suggestion or advice of agents 166 registered stallions, 2,024 registered bulls, 2,037 registered rams, and 2,037 registered boars. There were also procured at the suggestion of agents 2,034 registered cows. The agents saved many valuable sires from slaughter by having them transferred from one community to another; 2,045 were so transferred. One hundred and twelve live-stock breeding associations, with a total membership of 3,044, were organized by agents during the year.

DAIRYING.—The agents organized 215 cow-testing associations, and 82,190 cows were tested. As a result of this work 4,093 cows were discarded as unprofitable. Besides this, 2,734 cows were tested by individuals at the suggestion of the agents. Better feeding methods were inaugurated on 5,882 farms by the agents.

WORK IN RELATION TO CROPS AND SOILS.

The agents during the year secured the adoption of 3,225 crop-rotation systems. Nine hundred and sixty-four drainage systems, with a total area of 112,284 acres, and 194 irrigation systems, with

19,829 acres, were established by farmers under the direction or on the advice of the agents. In addition, 17,093 tons of chemical fertilizers were used at the suggestion of the agents, and 5,656 tons of chemical fertilizers were home-mixed and used at the suggestion of the county agents. Forty-two thousand two hundred and seventy acres of hay and pasture land were top-dressed, and 33,509 acres of legumes were plowed under at the suggestion of the agents. Five hundred and eighty-eight demonstrations, involving 20,214 acres, were conducted where records were kept of the increased yield in the soil-improvement work. These demonstrations gave a total increased value of \$218,182.93, or an average increase of \$10.79 per acre.

LIMING.—The correction of soil acidity by liming has been an important phase of soil-improvement work. Soils were tested for acidity on 10,638 farms, 268 sources of local lime deposits were developed, and a total of 210,987 tons of lime were used as a result of the agents' work. Five thousand six hundred acres in 351 liming demonstrations gave a net increased value of the crops grown of \$46,306.25, or an average increase of \$8.26 per acre.

WORK IN RELATION TO FARM BUSINESS.

ORGANIZATION.—One of the most important phases of county-agent work during the year was the assistance rendered farmers in organizing to do their own marketing and purchasing. Business organizations to the number of 417 were started as a result of the county-agent work. These did a total business of \$5,678,991.97, effecting an approximate saving of \$598,560 for their members.

FARM-MANAGEMENT DEMONSTRATIONS.—Another important phase of the county-agent work was the farm-management demonstration. Three thousand nine hundred and eighty-eight records were taken by the agents, and 4,739 records of this and previous years' work were returned to the farmers by the agents. One thousand three hundred and ninety-one farmers have reported a change in their system of farming as a result of these demonstrations. Eight thousand three hundred and thirty-seven farmers were assisted in keeping farm accounts.

COUNTY FARM BUREAUS.

One of the most encouraging features of the year's work was the development in the local organizations cooperating in county-agent work. Such organizations give the necessary local support for the best work of the agents. There are now 374 farm bureaus in the Northern and Western States, with a membership of 98,654. Many States now make the organization of a farm bureau a prerequisite for the appointment of an agent.

PROJECTING COUNTY-AGENT WORK.

In furthering their work the agents made 221,654 farm visits, received 245,227 office calls from farmers, and wrote 436,496 letters. They prepared 18,818 articles for the local press and mailed circular letters to the number of 1,791,291. They assisted in 2,388 extension schools in their counties, with a total enrollment of 357,807. They planned and conducted 900 observation trips, with an attend-

ance of 53,601. Ten thousand seven hundred and eleven demonstration meetings were held, with an attendance of 268,908.

FOOD PRODUCTION AND CONSERVATION.

At the outbreak of the war the farm bureaus and county agents made an immediate response. Surveys of the situation in regard to the availability of seeds, fertilizers, and labor were conducted, and in most cases arrangements were made for obtaining the seed and furnishing the labor. The agents were also able in many cases to assist in providing for better credit facilities and securing the efficient use of all available tractor power. The following special war-emergency projects deserve particular mention: (1) Increased acreage of spring wheat; (2) increased acreage of potatoes; (3) increased acreage of corn; (4) seed-corn selection and testing; (5) increased acreage of buckwheat, soy beans, and the grain sorghums. The total acreage of the crops named was increased enormously.

The war has made an emphatic demonstration of the usefulness of the county agent and of the farm bureau to a county and to the country. The farmers, through a county-wide organization and a trained leader, were able to act not only intelligently but quickly.

OUTLOOK OF COUNTY AGENT WORK.

The last year has seen a marked improvement in organized work. The county agents have greatly increased the number of their written projects, and these have been formulated in more detail, showing much more careful study of the teaching problems involved. Farmers understand better the possibilities and limitations of county-agent work and are assuming more and more the responsibility for local leadership, as shown in the greatly increased number of farm bureaus. All this promises well for the future of the work.

BOYS' AND GIRLS' CLUB WORK.

The boys' and girls' club work continued in charge of O. H. Benson.

During the year ended June 30, 1917, 29 Northern and Western States cooperated with this service in boys' and girls' club work. Seven hundred and fifty-nine counties in the North and West now have the junior extension work thoroughly organized into club groups and on a club-project basis. Eighteen agricultural and home-economics projects were carried out cooperatively. Eight States had written project agreements with State institutions like departments of education, normal schools, etc. Eighteen States had written project agreements with county organizations and institutions for doing club work.

During the year ended June 30, 1917, there were 1,124 paid leaders working in connection with the boys' and girls' club work. In addition to the paid leaders there were 9,748 volunteer club leaders. Two hundred and forty club leaders were paid cooperatively by the State and the United States Department of Agriculture, 133 by the State agricultural college and the local people, 18 by the college only, and 733 by the local people.

During 1916, 160 cooperative club leaders conducted 1,534 demonstrations in home canning and food conservation. At these demonstrations there was an attendance of 20,860 club members, 53,565 visiting men and women, and 14,152 boys and girls other than club members, a total of 88,577. The club leaders visited 12,698 club plats. In addition to this, local club plats were supervised by 4,367 volunteer club leaders.

A total of 2,083,606 copies of printed follow-up instructions was furnished to club leaders and club members during the year. This material was about equally divided between that supplied by the State agricultural colleges and the United States Department of Agriculture, and was in the main instructional matter intended especially for boys and girls enrolled in the regular club-project work.

The club work has gradually improved its organization for the proper supervision and direction of the work. There has been a steady tendency toward organizing members into club groups and having them work as such. Twenty-six of the 28 States, or 5 more than during 1915, reported that they were working definitely to perfect the work through organized club groups with leaders in charge.

The number of club members enrolled during 1916 was 198,759. Of this number 59,236 members completed all work, including making a report of the season's activities to the State club leader. However, 85,324 members actually did the work, although a part of this number failed to make complete reports at the close of the season. The 59,236 members completing all the work produced \$922,766.73 worth of products during the season, at an estimated cost, exclusive of overhead supervision, of \$332,836.07, leaving a net profit of \$589,930.66. These figures include payment to the members for the time expended in their work. A total of \$157,304.75 was expended for local, county, State, and National overhead supervision for club work. This is a supervision cost of 79 cents per club member enrolled, and 2.65 per club member making report on the completed season's activities.

In the corn-club work, 985 clubs were organized in 24 States in 1916, with an enrollment of 14,400. Final and complete reports were made by 3,918 members, who cared for 9,712 acres. On this acreage members produced 523,110.8 bushels of corn, the members invested \$142,867.37, including rent of land, cost of members' own labor, and all other items of expense. The average investment per member making final complete report was \$36.46, or 27.3 cents per bushel of corn produced.

Twenty-three States organized garden and canning clubs in 1916. The 1,160 garden and canning clubs had an enrollment of 24,254 members, of which 7,903 reported having canned 201,305.5 quarts of products, an average of 25.47 quarts per member. The total cost to members reporting was \$28,126.61, an average of \$3.56 per member.

In the pork and crop production club work in 1916, 25 States organized 3,174 members in 800 clubs. The members managed 5,300 animals, producing 728,411 pounds of pork, worth \$85,762.04. It cost \$42,675.58 to produce this pork, leaving a net profit to the members of \$43,086.46.

During the year ended June 30, 1917, there was a total enrollment of 406,636 members of regularly organized clubs. In addition to this about 400,000 boys and girls were enrolled in

the war-emergency projects—growing gardens, canning food products, raising poultry, making war bread, and doing other things of a special character. These were enrolled from the cities and were not classified as regular club members. The regular club members were organized into the following clubs: Corn clubs, 945; potato clubs, 1,217; home-garden clubs, 3,070; canning clubs, 2,152; garden and canning clubs, 776; mother-daughter clubs, 270; poultry clubs, 832; pig clubs, 1,037; baby-beef clubs, 158; bread clubs, 643; sewing clubs, 1,250; handicraft clubs, 76; sugar-beet clubs, 161; home cooking clubs, 755; and other miscellaneous clubs, 448; the total number of clubs of all kinds being 13,790. These clubs held regular meetings and elected their own officers.

During the period from December 1, 1916, to April 1, 1917, 3,589 club members attended the one or two weeks' short courses at the State agricultural colleges. One thousand five hundred and twenty-eight of these were champions of their respective counties in the boys' and girls' club work and were sent by the local people free of expense to attend the courses. Seventy club members are now attending the regular four-year agricultural college courses.

FARM-MANAGEMENT DEMONSTRATIONS.

Farm-management demonstrations, intended to teach that farming is a business and how farmers may apply business methods in organizing and administering their farms, were carried on, usually in counties where there was a county agricultural agent. The States in which this work is being conducted have one or more specialists, called farm-management demonstrators, who devote their entire time to assisting county agents in this project. The county agent is responsible for the work in his county; and the demonstrator, who is in the joint employ of the State and Federal Governments, is responsible for all the work in the entire State.

These demonstrations are brought to the attention of farmers by the demonstrators and county agents through personal contact, and by such means as news articles, posters, and circular letters. Farmers who are interested and who express a desire to cooperate in the work are assisted in starting records of their business. During the year they are aided, so far as is necessary, in keeping these accounts, and at the end of the year they are helped to summarize the records and to use the information secured in making plans for the business of the ensuing year. In some cases an estimated record is made of the business of the preceding year to interest farmers in keeping accounts by giving them some idea of the information an account book kept for a year will contain, and of the ways in which such information may be of value.

PROGRESS AND RESULTS.

During the past year demonstrators and county agents gave special attention to teaching farmers how to do the farm-demonstration work themselves, thus putting it on a self-help basis which makes for permanent results.

Up to June 30, 1917, farm-management demonstrations had been conducted in 283 counties in 27 States, an increase of 102 counties and 2 States within the year. A total of 16,431 farmers had started to

keep simple farm accounts, while 1,759 farmers had kept such records for one year or more.

Nearly every farmer who cooperated in keeping accounts used to some extent the information contained in his records. Illustrations of what was done are numerous and varied.

The plans for improvement were made by each farmer as a result of studying a record of his farm business and comparing his figures with averages of several near-by farms.

It has been of benefit to county agents to conduct farm-management demonstrations, because this work has impressed upon them the necessity of thinking at all times of the entire farm as the business unit with which the farmer is dealing.

EXTENSION WORK WITH FARM WOMEN.

The section of extension work with farm women was created near the close of the fiscal year 1915-16 with Miss Florence E. Ward in charge. Two well-defined types of women's work are cooperatively maintained by State, Smith-Lever, and department funds, (1) State-wide home-economics extension work and (2) home-demonstration agent work.

STATE-WIDE WORK.—The number of women employed in State-wide work, primarily with Smith-Lever funds, increased 30 per cent during the year. The special demand made by home makers awakened to their responsibility in matters of household thrift in connection with the war crisis has given this work additional impetus in every State. Home-economics specialists putting aside their usual varied program have inaugurated effective campaigns along food lines, such as increased food production, preservation of food, prevention of waste, use of perishables and local food products, conservation of special foods. Instruction has been given by means of extension schools, single lectures and demonstrations, exhibits, personal visits, and conferences. The number of full-time workers in the field has increased from 88, June 30, 1916, to 132, June 30, 1917.

The number of women organized in groups or clubs for the purpose of making the work of permanent value increased one-third during the year. This work is gaining steadily in efficiency from the standpoints of subject matter taught, methods employed, equipment and illustrative material used, standards instituted, and "follow-up" instructions given.

HOME-DEMONSTRATION AGENTS.—The home-demonstration agent work carried on by trained home-economics leaders and organizers who are permanently resident in a county or district was started practically at the close of the fiscal year 1915-16, but two such agents being employed cooperatively on the all-year basis at that time. During the year 1916-17, 15 workers have been added, as follows: New Haven County, Conn.; Blackhawk County, Iowa; Franklin, Hampden, Norfolk, Barnstable, and Worcester Counties, Mass.; Seward County, Nebr.; Cheshire and Sullivan Counties, N. H.; Monmouth County, N. J.; Otsego, Jefferson, and Cortland Counties, N. Y.; and Millard County, Utah.

Although this work is in its infancy in the Northern and Western States, reports from the field already indicate something of its value as a means of increasing the efficiency, the economic prosperity, and

the standards of living in farm homes. These home-demonstration agents, working intensively in small areas and in cooperation with the county agents, bring together, through the farm bureau or other county organization, educational, economic, and social agencies which are working to improve home conditions. They train local leaders, develop local groups or clubs, encourage community social life, unify and strengthen all the constructive forces for accomplishment, providing channels through which the State agricultural college and the department may bring information and help to the people.

Reports show that in the 15 counties 5,000 homes have been visited, 300 clubs have been organized, 4,160 demonstrations have been given, 18 State and county fairs have been assisted in exhibits, 6 home-improvement tours have been conducted, and 3 community canning centers have been established.

Reports show accomplishment along the following lines: Increased preservation of food which is in excess of immediate demand; increased practice of drying, brining, and salting; increased production of garden and poultry products; and increased knowledge of storage and refrigeration.

Reports also show such activities as the following: Market trips to study conditions and buying methods; organization, equipment, and supervision of canning centers; arranging with food producers and food dealers such as market gardeners, fruit growers, and commission merchants to preserve excess food by sending it to community centers for canning; establishing markets where women may sell their home-produced products; and giving publicity to food facts pertinent to the war situation through newspapers, posters, bulletins, exhibits, and lectures.

This work is developing satisfactorily, and plans for extending it are being made by nearly all the Northern and Western States.

EXTENSION SPECIALISTS.

In order to provide for the study of the methods of extension teaching in the different branches of agriculture as carried on by the agricultural colleges and the department in the several States, and for the planning and conduct of extension work of the various bureaus of the department in cooperation with the colleges, arrangements have been made by which extension specialists representing lines of work in which different bureaus are engaged are cooperatively employed by the respective bureaus and the States Relations Service. At present department bureaus are represented in the following subjects: Soils, forestry, horticulture, animal husbandry, and plant pathology.

Observations on the methods of extension teaching in extension schools, or short courses, were made in most of the States conducting such schools in the New England, Middle Atlantic, and Central Western States. The methods used in crop and soil improvement were observed in New England States and in a few of the Central States. A few of the Central States were visited by the extension specialist in horticulture to secure information on orchard improvement demonstrations, and the extension specialist in forestry conferred with several extension directors of the Central Western States with a view to promoting a greater interest in the farm wood lot, the

reforesting of hill and other waste land, and the use of cordwood on the farm in order to increase the use of wood as fuel and to lessen the necessary transportation of coal.

Upon the declaration of the existence of a state of war the efforts of each specialist were turned toward food-production and conservation methods. The crop specialist centered his attention upon demonstrations which not only improve soils and help to establish profitable rotations but promote the economical production of home-raised feeds, especially in the dairy districts; the horticultural specialist sought to increase the yield of vegetables as well as to increase planting by preparing gardening bulletins for boys' and girls' club work. The animal husbandry specialists assisted the State leaders of boys' and girls' clubs in the formation of pig clubs, baby-beef clubs, and poultry clubs, and in disseminating information concerning egg production, grainless poultry rations, etc.

Through the cooperative efforts of the Forest Service and the States Relations Service a project was approved whereby the forest rangers may serve to a limited extent as the agricultural agents representing the State agricultural colleges in promoting agriculture on the National Forests. About the close of the fiscal year the forestry-extension specialist was temporarily transferred to the county-agent section to assist with the emergency organization for greater food production and conservation.

The work of these specialists in carrying the department's information along subject-matter lines to the various extension divisions of the States for transmittal to the man on the farm and also in studying and carrying from State to State knowledge of the most efficient organization and practices in extension work along each line is proving especially helpful as a connecting link between the research workers of the Federal department and the extension divisions of the States.

OFFICE OF HOME ECONOMICS.

C. F. LANGWORTHY, *Chief.*

R. D. MILNER, *Assistant Chief.*

The work of the Office of Home Economics as originally planned for the year was greatly modified owing to the war situation, especially for the purpose of furnishing exact data on which food discussions can be based and information regarding the rational and economical use of foods, this being a part of the general plan to insure the most efficient use of our food resources for the benefit of the United States and the Allies. Special attention was paid to the house-keeper's problems, with a view to showing her how foods and food combinations can be used in such a way that the diet will be satisfactory and adequate and yet effect a saving of various commodities especially needed for war purposes.

Studies on the digestibility and uses of culinary and table fats were continued, special attention being given to vegetable fats, such as nut oils and fruit-seed oils, which are little known or used, and

which may be properly called agricultural by-products, to determine whether or not they are suited for use in the home for food purposes. Two bulletins reporting digestion experiments with vegetable and animal fats were published, also a bulletin summarizing data on fats and their economical use in the home.

In continuation of work on the digestibility and uses of cereal foods attention was paid particularly to wheat flour made by the old-fashioned milling process, kafir, feterita, milo, kaoliang, and buckwheat, and the influence of fineness of grinding and of preparation on the food value of these and other grains. A bulletin on the digestibility of grain sorghums and also a paper reporting the digestibility of millet and proso meal were published. From the work with millet and proso the general conclusion was drawn that, while bread from these meals contributes to the protein of the diet, the grains thus used would be decidedly more important as a source of carbohydrates.

Special studies of home canning of animal and vegetable products were undertaken, a part of which included comparative studies of domestic methods of canning.

The preparation of food for the table was studied also, including the use of dried fruits and vegetables, especially those made by domestic methods, this work being a part of the general study undertaken by the department on the preparation and use of such dried foods.

Attention was given to potatoes and their more extended use as a starchy food, and to the preparation of various grains in palatable forms as substitutes for wheat.

A special feature of the year's work had to do with the planning of meals with a view to supplying housekeepers with nontechnical information which will enable them to plan rationally chosen, palatable, and economical meals. As a result of this work three Farmers' Bulletins on food selection were published, which deal, respectively, with the body's food needs, cereal foods, and foods rich in protein. Farmers' Bulletins which deal with other aspects of the question are in preparation. A Farmers' Bulletin of similar character, entitled "Fresh Fruits and Vegetables as Conservers of Other Staple Foods," also appeared.

The preparation of general summaries on food topics was continued. Those which have been published have dealt with potatoes, sweet potatoes, and other starchy roots as food; turnips, beets, and other succulent roots and their use; eggs and their value as food; the food value of poultry; and homemade fireless cookers and their use.

In carrying on its work the Office of Home Economics cooperated with other bureaus and with other departments. In cooperation with the Food Administration and with the Bureau of Education of the Department of the Interior 10 lessons on food conservation were prepared. One of the lessons discusses the fundamentals of an adequate diet, and the others deal with food-conservation problems. Cooperative work on food carried on during the year included studies of emergency rations for the United States Army and Navy and of general questions of rationing for the Coast Guard Service. In cooperation with the Bureau of Fisheries of the Department of Commerce studies on the preparation of fish for the table, its digesti-

bility, and its preservation by domestic methods were undertaken. Dietary studies were made in selected families of the District of Columbia as a part of the study of living conditions in the District carried on by the Department of Labor.

Clothing and textile work dealt largely with cleaning processes, with a view to prolonging the period of usefulness, a matter of importance in connection with household thrift. A technical bulletin on spots and stains and their removal was prepared for publication, and a Farmers' Bulletin on the same subject was published. Attention was also given to the problem of care and repair of floor coverings.

As part of the work with household equipment other than textiles a special study was made of the electrolytic method of cleaning silver, which yielded results of technical as well as practical value. Other work in this field had to do chiefly with problems of cleaning and care, with the result that material has accumulated for use in a popular discussion of the subject. General questions which relate to the selection and arrangement of household equipment were also considered.

In connection with the studies of household labor, additional information was collected regarding the time devoted to different household tasks in rural homes.

Definite statements regarding the physical demands made by household labor require respiration-calorimeter experiments. In view of the fact that the respiration calorimeter used for this work needed some repairs, it was deemed advisable to reconstruct portions of it, and this was done, with the result that a standardized method of construction has been fixed upon which not only makes for accuracy and ease of operation, but which so cheapens construction that a respiration calorimeter should be within the reach of any well-equipped laboratory. Respiration-calorimeter studies undertaken in cooperation with the Bureau of Entomology on the wintering of bees were continued, as was a project in cooperation with the Bureau of Animal Industry relating to the incubation of hens' eggs.

A bulletin designed particularly for the use of the extension offices of the service was prepared for publication on sewing and on the making of canning-club uniforms. A part of this was published as a circular.

Throughout the year special attention was given to the accumulation of information for use by the extension offices of the service and to the preparation of short reports and summaries and articles for popular use. The war situation greatly increased the demand for short, popular articles, with the result that a hundred or more were prepared.

REPORT OF THE DIRECTOR OF THE OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF PUBLIC ROADS AND RURAL ENGINEERING,
Washington, D. C., October 15, 1917.

SIR: I have the honor to submit herewith the report of the Office of Public Roads and Rural Engineering for the fiscal year ended June 30, 1917.

Respectfully,

L. W. PAGE, *Director.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

INTRODUCTORY.

The administration of the Federal aid road act, approved July 11, 1916, so broadened the scope of the office as to necessitate an entire reorganization. To meet the new conditions, the work of the office was grouped in two branches, known, respectively, as the engineering branch and the management and economics branch. At the head of these two branches were placed a chief engineer and a chief of management, respectively, who reported to the director. Two general inspectors were appointed, reporting immediately to the director and operating independently of the two branches. The field work was organized into 10 districts, numbered from 1 to 10, respectively. A district engineer was placed in charge of the work of each district and reported directly to the chief engineer.

FEDERAL AID ROAD ACT.

The Federal aid road act marked a long advance in Federal policy concerning the improvement of the public highways. For more than 20 years the efforts of the Federal Government had been restricted to research and education for the purpose of developing improved methods of road construction and maintenance and imparting useful knowledge along these lines to local road builders. The Federal act carried a large appropriation, \$75,000,000, to be expended during the five-year period in connection with at least an equal amount to be provided by the States in the construction of post roads. The act also carried an appropriation of \$10,000,000 to be expended in forest road improvement, but this phase of the act will be dealt with in a separate section of the report.

Under the authority contained in the act to make rules and regulations there were called into conference at Washington on August 16, 1916, the heads of the various State highway departments, and to them was submitted a draft of rules and regulations which had been prepared in this office in cooperation with the solicitor of the

department and tentatively approved by the Secretary. Most of the suggestions made by the State highway officials were incorporated in the final draft of the rules and regulations, which were accordingly issued on September 1, 1916.

The most important outcome of this Federal legislation was the enactment of State laws providing effective State control of a large measure of road work, making funds available to meet the Federal appropriations, systematizing the work so that there might be definite and correlated results instead of haphazard construction, and finally, strengthening very greatly the States' participation in road maintenance. At the time the Federal act was passed, the States of Delaware, Georgia, South Carolina, Indiana, Texas, and Nevada had no semblance of a State highway department, and it was ascertained that the States of Florida, Arkansas, Oklahoma, Michigan, Missouri, Kansas, South Dakota, Idaho, and Wyoming would require additional legislation in order that their highway departments could perform the functions contemplated by the Federal aid road act. By the close of the fiscal year 1917 every State in the Union had a State highway department within the meaning of the Federal aid road act and had given adequate assent to the terms of the act. For this beneficial result in organization the Federal aid road act must be considered mainly responsible.

At the time of the passage of the act there were 33 States which had made provision for definite highway systems, embracing the important roads of the State, established by law or by authority of the State highway department. Since that time seven States have established or authorized the establishment of such definite systems of highways.

During the calendar year 1916 the total expenditure of funds under State supervision for construction was \$49,884,155; for maintenance, \$18,452,861; and for all highway purposes a total of \$74,495,554, of which \$40,969,001 were State funds. Very greatly increased State appropriations were made as a direct result of the passage of the Federal act. The calendar year 1917 would of course not register the full measure of increase, as some of the appropriations to meet the Federal aid road act were not made until the spring of 1917, but it is estimated that the aggregate expenditures of State funds for the calendar year 1917 will be \$60,000,000 as compared with \$40,969,001 for 1916. A number of States have made specific appropriations to meet Federal aid dollar for dollar. Among these may be mentioned New York, Illinois, Michigan, Rhode Island, Nevada, Iowa, Florida, and Vermont.

While the Federal act was not exacting in the matter of requiring maintenance assurances, it is gratifying to state that through the cordial cooperative spirit of the State officials a great amount of excellent maintenance legislation was enacted, following the passage of the Federal act. While in 1916 provision existed for State participation in road maintenance in 33 States, in 1917, 42 States had made such provision.

From an engineering and construction standpoint one of the results of the Federal act and of the rules and regulations has been a standardization of form and arrangement for highway plans and specifications. This should in time prove of great value, not only

to the Federal Government, but to the States, by way of encouraging simplicity and standardization. Still further progress was made by voluntary cooperation on the part of the State officials through a conference of testing engineers, held at this office, on February 12-17, 1917. This conference recommended to the States standard forms of specifications for materials, standard methods of testing materials, standard forms for reporting test results, and standard methods of sampling materials. A committee of the American Association of State Highway Officials, working in conjunction with officials of this office, formulated standard specifications which should prove most helpful to highway work in the various States.

From the foregoing it is evident that, aside from the material benefits involved in the appropriation of Federal funds to aid highway construction, there has already been brought about a vast amount of benefit through improvement in organization and methods, and in the correlation, systematizing, and standardizing of highway work.

Considering the immense amount of preparatory legislation and the working out of rules and regulations, bases of procedure, and the establishment of the necessary organization, the fiscal year 1917 makes an impressive showing as to actual road construction under the terms of the act. At the close of the fiscal year there had been received for consideration by the department 92 projects from 26 States, involving an aggregate length of 948.78 miles at an estimated cost of \$5,435,702, on which Federal aid was requested to the extent of \$2,433,934. Of these projects 23 had been approved at the close of the fiscal year, involving a total length of 188.58 miles at a total estimated cost of \$1,845,433, for which Federal aid was requested to the amount of \$846,152. The projects as approved are shown in the following table:

Post-road projects approved at close of fiscal year ending June 30, 1917.

State.	Project No.—	Reconnaissance estimate of cost.	Federal aid requested.	Length in miles.
Arizona.....	1	\$111,499.41	\$55,749.70	(1)
California.....	1	70,654.40	35,327.20	4.24
Do.....	3	54,723.66	25,500.00	2.55
Connecticut.....	1	111,425.90	53,000.00	5.3
Maine.....	1	257,248.87	128,624.43	15.57
Do.....	2	53,156.03	16,730.07	6.98
Maryland.....	1	33,100.43	16,550.21	2.01
Do.....	2	71,103.00	33,200.00	3.32
Michigan.....	2	79,772.55	39,886.28	5.983
Minnesota.....	1	160,000.00	80,000.00	50
Do.....	2	110,000.00	55,000.00	31.5
Do.....	5	46,200.00	23,100.00	16
Do.....	8	24,000.00	12,000.00	6.25
New Hampshire.....	1	14,989.70	7,494.85	1.2
North Carolina.....	1	51,956.52	10,000.00	(1)
Do.....	2	26,392.83	10,000.00	7.75
Do.....	3	25,985.83	10,000.00	3
Pennsylvania.....	1	70,857.65	26,750.00	2.675
Do.....	2	160,433.53	64,800.00	6.43
Do.....	3	138,466.49	62,340.00	6.234
Rhode Island.....	1	83,262.85	34,997.13	3.66
Virginia.....	1	28,473.50	14,236.75	4.38
Washington.....	1	61,730.45	30,865.22	3.5
Total.....	23	1,845,433.60	846,151.84	188.582

¹ Bridge.

NATIONAL FOREST ROADS.

Previous to the establishment of the district organization the national-forest road work, handled by the Office of Public Roads and Rural Engineering for and in cooperation with the Forest Service, was carried on through an engineer representative at each of the six western forest district headquarters, with the exception that no representative was stationed at the Missoula office. Road construction and maintenance under section 8 of the Federal aid road act, involving the expenditure of a Federal appropriation of \$1,000,000 annually for 10 years, was entrusted to this office. Since January 1, 1917, the present district organization of this office therefore has actively conducted the engineering and construction in connection with forest road work, except the minor projects under the 10 per cent fund and a portion of the maintenance work, which have been executed by the Forest Service.

During the year requests have been made by the Forest Service for reconnaissance surveys and preliminary investigations covering approximately 4,587 miles, 2,435 miles being for reconnaissance surveys, and 2,152 miles preliminary investigations, distributed over 172 projects.

The work completed is as follows: Reconnaissance surveys, 1,245 miles; location surveys, 202 miles; preliminary investigations, 652 miles; maintenance work, 119 miles; and construction, 37 miles.

The large mileage covered by requests received from the Forest Service for preliminary investigations and reconnaissance surveys in proportion to the mileage of such investigations and surveys completed is due to the fact that most of these requests were filed near the close of the fiscal year, at the time when the field forces of this office were being organized for the work of the first season.

One of the projects completed during the year is the Kamas-Stockmore. This road is 38 miles in length, extends from Kamas, in Summit County, to Stockmore and Hanna, in Duchesne County, Utah, and furnishes a direct route from Salt Lake City, Park City, Coalville, and Kamas to towns in the northern portion of the Uinta Basin.

The unfinished section of the Questa-Elizabethtown project, in the Carson National Forest, N. Mex., was completed, and the road is open to traffic. This road is a link in the route over the otherwise impassable divide of the Sangre de Christo Mountains, which form the backbone of the La Platte and Rio Grande River watersheds, and provides a direct route from Cimarron, Raton, and other neighboring towns into the upper Rio Grande Valley.

Construction was completed over a short section of the Blewett Pass project in Washington. This road is located in Chelan and Kittitas Counties, affords communication between the Wenatchee, Kittitas, and Yakima valleys, and offers the shortest connection between that section of the Sunset Highway extending over the Snoqualmie Pass and Chelan and that portion between Wenatchee and Waterville.

The Rabbit Ears Road, in Colorado, a 10 per cent project, on which work was started in 1913, a portion being done each year since, was completed, 2.1 miles having been constructed this year. This road is about 20 miles long, and furnishes an important highway between

Denver and the northwestern part of Colorado and facilitates interstate travel into Utah by way of the Uinta Basin.

Location surveys were authorized on the following projects: Seeley Lake, in Missoula County, Mont., Missoula National Forest; Bernice, in Jefferson County, Mont., Deerlodge National Forest; Wind River, in Fremont and Lincoln Counties, Wyo., Teton National Forest; and Belt Creek, in Cascade County, Mont., Jefferson National Forest.

Construction was authorized on the Salmon River Road, Siskiyou County, Cal., Klamath National Forest, and on the Warm River-Yellowstone, Fremont County, Idaho, Targhee National Forest.

Construction was under way on approximately 159 miles of road, distributed over projects as follows:

	Miles.		Miles.
Arizona:		Minnesota: Stony River-----	31.00
Salt River-Pleasant Valley-----	3.90	New Mexico:	
Winslow-Long Valley-----	2.40	Glorietta-Panchuela-----	1.5
Camilla-Ft. Huachuca-----	2.10	Questa-Ellizabethtown-----	.4
Total-----	8.40	Total-----	1.9
California:		Oregon: MacKenzie-----	3.0
Laguna-----	9.00	South Dakota: Deadwood-Hot	
Palomar-----	10.00	Springs (Silver Lake sub-	
Salmon River-----	4.00	section of Custer Hill City	
Trinity River-----	8.00	section-----	4.80
Total-----	31.00	Utah: Ephraim-Orangeville---	.70
Colorado:		Washington: Blewett Pass---	7.00
Sedalia-Decker-----	18.60	Wyoming:	
Rabbit Ears-----	18.30	Buffalo-Tensleep-----	10.50
Total-----	36.90	Teton Pass-----	21.00
Idaho: South fork of Payette		Total-----	31.50
River-----	3.25	Grand total-----	158.95

The following is a statement of bridge work in connection with national forest projects:

Plans for forest bridges.

Project.	State.	County.	Type of span.	Main span.
Completed:				Feet.
Trinity River-----	California	Trinity	Suspension-----	233½
Medford-Crater Lake---	Oregon	Jackson	Preliminary sketches-----	
In progress:				
Salmon River-----	California	Siskiyou	Wooden truss-----	120
Cass Lake-Pine-----	Minnesota	Cass	Steel girder and pile trestle approaches.	60

ROAD CONSTRUCTION.**EXPERIMENTAL ROADS.**

The amount appropriated by Congress for field experiments in road work was \$60,000. Continuing the previous policy of the office, all the field experiments made during the fiscal year have been in the vicinity of Washington and have been divided in the same two classes as formerly, namely:

1. New experimental construction.
2. Maintenance of experimental roads already constructed.

NEW CONSTRUCTION.

The new construction completed includes a bituminous gravel concrete road surface about $4\frac{1}{4}$ miles long between Alexandria and Gum Spring in Fairfax County, Va., and a surface treated gravel road about 2 miles long from Gum Spring to Mount Vernon, in Fairfax County. The purpose of the first experiment was to devise some method of utilizing local gravel in the construction of a high-class bituminous concrete road surface suitable for all sorts of travel. The purpose of the second experiment was to determine the best way of utilizing bituminous materials in the surface treatment of existing gravel roads so as to provide for fairly heavy automobile traffic without the rapid deterioration of the surface. The experiment includes three different surface treatments. Both of the experiments in new construction are described in detail in Department Bulletin No 586, issued by this office, in which costs, methods, and results are tabulated.

At the close of the fiscal year construction was in progress on an experimental topsoil road through the Chapawamsic Swamp in Prince William County, Va., about 4 miles long.

ROAD MAINTENANCE.

The remainder of the fund appropriated for road experiments has been devoted to the maintenance of existing experimental roads in Montgomery County, Md., and Alexandria County, Va. The methods employed in maintaining the various experimental sections, the results obtained, and the distribution of costs are all shown in Department Bulletin No. 586.

POST ROADS.

In the last annual report of the director mention was made of 14 post-road projects completed prior to July 1, 1916. During the fiscal year two additional projects have been completed, namely, the Licking and Muskingum Counties (Ohio), post road, 24 miles, and the McDowell County (N. C.), post road, 13.3 mile long. With the 397.6 miles previously reported, this brings the total mileage of post roads already completed to 434.9 and leaves the project at Dubuque, Iowa, 19.2 miles long, as the sole remaining uncompleted post road. This was near completion at the close of the fiscal year.

ROAD BUILDING AND MAINTENANCE INVESTIGATIONS.

The amount appropriated by Congress for road building and maintenance investigations was \$141,780. This appropriation has been devoted to the continuation of the regular activities of the office along educational lines. The work has been classified under the following heads:

1. Supervising the construction of object-lesson roads.
2. Making surveys and preparing plans for designated sections of roads, such work to serve as a model for local highway officials.
3. Planning model highway systems for entire counties.
4. Furnishing special advice in connection with local road problems.
5. Object-lesson maintenance.
6. Bridge work.
7. Cooperation in the improvement of national park and forest roads.
8. The collection and dissemination of information pertaining to all phases of road building and maintenance.

OBJECT-LESSON ROADS.

Engineers were furnished to supervise the construction of object-lesson roads in the following-named places, listed by States: Arkansas (1), Alma County; Georgia (1), Echols County; Louisiana (1), Beauregard Parish; Michigan (1), Branch County; Mississippi (1), Madison County; Missouri (1), Christian County; Nebraska (4), Buffalo, Dawes, Fillmore, and Sheridan Counties; North Dakota (3), Burleigh, Morton, and Benson Counties; Oklahoma (3), Hughes, Payne, and Pottawatomie Counties; South Carolina (1), Hampton County; and Virginia (4), Albemarle, Greensville, Northampton, and Sussex Counties. Twenty-one object-lesson roads were built during the present fiscal year.

An engineer was assigned to each of the following counties: Albemarle, Greensville, Northampton, and Sussex in Virginia; Pottawatomie, in Oklahoma; and Monroe, in Indiana. They will supervise a number of important road projects under way in those counties. A bulletin now in course of publication presents data showing the amount of work done in connection with each object-lesson road, as well as a detailed distribution of costs.

SURVEYS AND PLANS.

Surveys actually were made and plans prepared in the following States: Georgia (1), Floyd County; Kentucky (1), Henderson County; Louisiana (1), Natchitoches Parish; Maryland (1), Prince Georges County; Tennessee (2), Dickens and Perry Counties; and Virginia (1), Loudoun County. In many cases assistance also was given to local officials in organizing survey parties in connection with assignments made for other purposes.

MODEL HIGHWAY SYSTEMS.

Model highway systems were planned after thorough investigation, in the following named States and counties: Alabama (2), El-

more and Madison; California (2), Santa Cruz and Yuba; Georgia (1), Appling; Kentucky (2), Henderson and Warren; Mississippi (1), Monroe; Oklahoma (1), Caddo; South Carolina (4), Abbeville, Beaufort, Colleton, and McCormick; Texas (21), Callahan, Clay, Cottle, Crosby, Denton, Dickens, Eastland, Ector, Floyd, Howard, Lubbock Midland, Montague, Nolan, Orange, Parker, Reeves, Stonewall, Throckmorton, Williamson, and Wise; Virginia (1), Northampton; Washington (1), Skamania; and Wyoming (1), Big Horn.

In most cases these model systems planned by our engineers are already being used by county officials as a basis for determining proper tax levies or bond issues for highway purposes.

SPECIAL INSPECTION AND ADVICE.

Inspections were made and advice furnished in connection with special road problems in the following States and counties: Alabama (1), Elmore; Georgia (3), Fannin, Glynn, and Pickens; Indiana (1), Jackson; Kentucky (1), Franklin; Maryland (2), Montgomery and Prince Georges; Mississippi (2), Pearl River and Lowndes; Nebraska (3), Buffalo, Holt, and Polk; Nevada (2), Ormsby and Washoe; North Carolina (4), Craven, Durham, Haywood, and Wayne; Oklahoma (6), Atoka, Bryan, Greer, Harmon, Kiowa and Rogers; Oregon (1), Hood River; South Carolina (6), Cherokee, Chester, Greenwood, Hampton, Orangeburg, and York; Texas (16), Brooks, Chamber, Comanche, Erath, Fannin, Kendall, Kerr, Live Oak, McCulloch, Nueces, San Patricio, Schleicher, Stephens, Sutton, Traverse, and Tom Green; Virginia (5) Clarke, Fairfax, Fauquier, Prince William, and Wise; and Wyoming (1), Fremont.

In addition to the above special assignments one engineer each was assigned to Kentucky, Louisiana, Oklahoma, Tennessee, Texas, and West Virginia for the purpose of assisting the State highway departments in handling similar problems.

Engineers also were assigned to consult with Army engineers in connection with road work in the cantonments at Fort Sill and Little Rock, Ark. Just at the close of the fiscal year engineers were assigned to the Army cantonments at the following named places: Fort Sam Houston, Tex.; Yaphank, Long Island; Louisville, Ky.; Fort Riley, Kans.; Atlanta, Ga.; Petersburg, Va.; Admiral, Md.; Battle Creek, Mich.; Wrightstown, N. J.; Little Rock, Ark.; American Lake, Wash.; Rockford, Ill.; Columbia, S. C.; Ayer, Mass.; Chillicothe, Ohio; and Des Moines, Iowa, for the purpose of supervising the road work in and around the cantonments, which will be reported on in the next annual report.

OBJECT-LESSON MAINTENANCE.

Three engineers were employed constantly in the maintenance of the Washington-Atlanta Highway, and two engineers were assigned to similar work on the Central Highway in North Carolina. The work was done in cooperation with the States and counties traversed and was for the purpose of stimulating interest in road maintenance.

At the close of the fiscal year, the engineers were withdrawn from the above projects and the work turned over to the county officials,

It is proposed, however, to observe the effect upon local organizations of the work done by the office engineers and a complete report of the project, including detailed descriptions of methods, costs, and results, will be published.

BRIDGE WORK.

Designs for bridges were prepared for the following-named States: Florida, 1; Indiana, 1; North Carolina, 1; Oklahoma, 1; Tennessee, 1; Virginia, 4; a total of 9. Engineers were assigned to investigate existing and proposed bridges as follows: Florida, 1; Indiana, 1; Kentucky, 1; North Carolina, 2; South Carolina, 1; Virginia, 7; a total of 13, and estimates of the cost of proposed bridges were made as follows: Minnesota, 1; North Carolina, 1; Texas, 1; Virginia, 1; a total of 4.

In addition, general designs and specifications prepared by State highway departments and local officials were examined and reviewed as an assistance to various local communities.

COOPERATION IN THE IMPROVEMENT OF NATIONAL PARK AND FOREST ROADS.

Engineers were furnished to cooperate with the Forest Service and with local highway officials in the location, design, and construction of roads. Assistance in preparing plans or making surveys was given as follows: Arizona, 10 projects; California, 7 projects; Colorado, 26 projects; Idaho, 1 project; Minnesota, 2 projects; Montana, 1 project; New Mexico, 8 projects; Oregon, 2 projects; South Dakota, 1 project; Utah, 5 projects; Washington, 3 projects; Wyoming, 1 project.

Assistance in supervising the construction of roads was given as follows: Arizona, 5; California, 8; Colorado, 4; Idaho, 2; Minnesota, 1; Nevada, 1; New Mexico, 3; Oregon, 3; South Dakota, 1; Utah, 6; Washington, 3; Wyoming, 4.

Assistance in supervising the maintenance of forest roads was furnished as follows: Colorado, 1 project; Idaho, 2 projects; New Mexico, 1 project; Oregon, 4 projects; South Dakota, 1 project; Utah, 6 projects; and Washington, 4 projects.

THE COLLECTION AND DISSEMINATION OF INFORMATION.

The office has continued its policy of keeping in touch with the work being done by State and local road officials throughout the country, especially where unusual methods were being employed. The information gained in this way is being disseminated constantly throughout the country by means of both published bulletins and letter correspondence.

ROAD MANAGEMENT AND ECONOMICS.

ECONOMIC HIGHWAY SURVEY.

In preparing for cooperation with the States under the terms of the Federal aid road act, it was found that, while a vast amount of information was available concerning highways in the various States, it was uncorrelated, fragmentary, and seriously lacking in essential details. To meet the needs of this office and of the State highway

departments, an economic highway survey, involving complete map and text information, was planned, and through cooperation with the State Roads Commission of Maryland an actual field survey was begun in that State. Cooperation was established with the Corps of Engineers of the United States Army, with the committee of military research of the Council of National Defense, and with the Post Office Department. The results of the survey have been gratifying and have proved to be not only of great economic value but of decided benefit to the War Department. Details of this work are deemed to have a confidential value and will, therefore, not be set forth in this report.

GENERAL ECONOMIC AND STATISTICAL WORK.

The results of the 1914 census relating to mileage of improved and unimproved roads, taxation, revenues, and bond issues were published in a series of five bulletins. The first investigation of this kind was made for the year 1904 and the second for 1909. As an indication of the progress of road work in the various States this road census has proved very valuable, and it is planned to repeat it every fifth year. Data collected showed 257,291.54 miles of surfaced road in 1914 as against 153,530.40 miles in 1904, an increase of 93,761.14 miles in the 10-year period, and a total expenditure of \$240,263,784.46 upon roads in 1914, as against \$79,623,616.33 in 1904, an increase of \$160,640,168.13 for the 10-year period.

Current data was collected and published relating especially to State highway mileage and expenditures, to automobile registrations, and to the disposition of revenues derived therefrom. In connection with this work a State index is maintained for ready reference showing the annual progress of State road work in each State.

ECONOMIC STUDIES OF STATE HIGHWAY SYSTEMS.

The State highway studies were continued during the year. The object of these is to ascertain the character, organization, and duties of State highway departments; the class of roads to which the aid of the State is extended; the character, cost, and extent of the work done; the methods of procedure in construction and maintenance of State and State-aid roads and bridges; the system of reports and records; and the sources, amounts, and disposition of State funds applied to roads. The completion of this investigation has been delayed on account of the fact that new legislation has been enacted recently in most all of the States, necessitating the organization of new departments in some States and in others changes in the organization and procedure in order that the States might avail themselves of Federal aid. The results will be published in a series of bulletins, the first of which, dealing with organization and procedure, is in course of preparation. Each important phase of the subject will be treated in a separate publication.

ECONOMIC STUDIES OF COUNTY AND TOWNSHIP SYSTEMS.

About 100 counties and townships have been selected in various parts of the United States in which studies are being made to ascer-

tain the present local road organization, costs of operation, results obtained, procedure in construction, types of roads, character of materials used, systems and methods of maintenance, etc. The object of the study is to determine the elements of weakness in the various local systems of management and to form the basis for a series of bulletins dealing with local road construction, maintenance, and administration. One of these bulletins, dealing with cost keeping, is ready for publication.

UTILIZATION OF CONVICT LABOR IN ROAD BUILDING.

A bulletin was published during the year giving the results of a study conducted by the office dealing with the management, operation, discipline, systems of record and cost keeping, and the results obtained in convict road camps under cooperative arrangements with State highway departments, State prison commissions, and local road authorities.

OBSERVATION OF EXPERIMENTAL CONVICT CAMP.

A study was made of an experimental convict-labor road camp constructed and maintained by the County Commissioners of Fulton County, Ga., in cooperation with this office; the Public Health Service of the War Department, the Office of Home Economics of the States Relations Service of this department, and the State Prison Commission of Georgia.

The object of this study was to ascertain the efficiency, economy, and practicability of applying modern methods of penology, sanitation, health, dietetics, and management to convict labor camps. The results of this study have been compiled and are now in course of publication.

ECONOMIC STUDIES OF SELECTED POST ROADS.

In conformity with the provisions of the Post Office Department appropriation act of August 24, 1912, economic studies of the 17 post roads in various parts of the United States were continued during the year. The final report to Congress, which will be made in conjunction with a similar report by the Post Office Department, is now in course of preparation.

TRAFFIC STUDIES.

Traffic studies were continued on experimental roads in the neighborhood of Washington. The office is gradually accumulating a mass of traffic data which eventually will be of valuable assistance in solving construction and maintenance problems.

ADDRESSES, LECTURES, AND PAPERS.

The office has continued to render expert advice on legislation, organization, management, construction, and maintenance and to disseminate information through conferences, lectures, and the preparation of papers. In this work the office has cooperated closely with State authorities. An effort has been made during the year to

confine the attendance at meetings to gatherings of official bodies, and to meetings and conferences of sufficient importance to justify the attendance of department representatives.

A total of 263 lectures and addresses were delivered, as compared with 655 lectures in 1916. The total attendance at meetings was 43,184, as compared with 92,610 in 1916. The average attendance was 164, as compared with 142 for the previous year. These lectures and addresses were delivered mostly before scientific, civic, and agricultural organizations and before road schools held at universities and colleges. The road schools were attended largely by local road officials, thus giving the office an excellent opportunity to convey helpful advice and information to those who are actually in charge of local road work.

MODELS AND EXHIBITS.

Models and other exhibit materials were used during the year at expositions, conferences, conventions, and fairs to illustrate the best methods of road, bridge, and culvert construction, road drainage, maintenance, repair, roadside treatment, equipment, machinery, etc. This exhibit material is built and maintained by the office, but all expenses in connection with its transportation, installation, and demonstration are paid by the organizations benefited.

This work was carried on in cooperation with the Office of Exhibits. Exhibits were made during the year at the places and under the organizations indicated as follows:

Third annual convention of the Cotton States Merchants' Association, Memphis, Tenn., August, 1916.

State Fair, Louisville, Ky., September, 1916.

State Fair, Syracuse, N. Y., September, 1916.

Southern Appalachian Good Roads Congress, Lexington, Ky., September, 1916.

Westchester, Pa., County Fair, September, 1916.

Dry Land Congress and Exposition, El Paso, Tex., October, 1916.

New York conferences of road supervisors, Jamestown, N. Y., October and November, 1916.

Grange Golden Jubilee, Ashville, N. Y., September, 1916.

Western Pennsylvania Exposition, Pittsburgh, Pa., August and September, 1916.

State Fair, Columbia, S. C., October, 1916.

National Farm and Live Stock Show, New Orleans, La., November, 1916.

Iowa State College, Ames, Iowa, August, 1916.

Lucas County Fair, Toledo, Ohio, August, 1916.

San Diego, Cal., Exposition, July, 1916, to January, 1917.

Cement Products Exposition, Chicago, February, 1917.

American Road Builders, Boston, Mass., February, 1917.

Massachusetts Institute of Technology, Cambridge, Mass., February to September, 1917.

PHOTOGRAPHIC WORK.

The photographic laboratory prepared 2,248 negatives, 10,793 prints, 1,383 lantern slides, and 282 bromide enlargements. There

were 2,286 new slides colored for lecture work. Fifty-seven sets of lantern slides were loaned to various individuals and organizations, exclusive of those used in lecture work by employees of the office. At the close of the year the photographic files contained 17,685 negatives, 47,104 prints, 12,134 slides, and 1,328 bromide enlargements.

ROAD MATERIAL TESTS AND RESEARCH.

General lack of uniformity in specification requirements for all types of road materials induced the office to call a conference of State highway testing engineers and chemists for the purpose of establishing standard forms of specifications and standard methods of sampling, testing and reporting test results on road materials. Twenty-one States sent representatives to Washington to attend the conference, which was in session for six consecutive days. The recommendations of this conference have been prepared for publication as a department bulletin. These recommendations include 41 standard forms of specifications for materials to be used in various types of road construction. The materials covered are broken stone, stone block, broken slag, gravel, sand, topsoil, sand clay, mineral filler, road oils, asphalt cements, tars, Portland cement, concrete, steel reinforcing, and brick. The conference also recommended standard methods of sampling, testing, and reporting test results for these materials.

One thousand three hundred and forty-five samples were analyzed or tested in the laboratories during the fiscal year. The slight decrease of approximately 7 per cent as compared with the preceding year was due to an unusually large number of samples of culvert metal tested during that year.

ROUTINE CHEMICAL TESTING AND INSPECTION.

Four hundred and twenty-six samples were examined in the chemical laboratory. This represents a decrease of about 10 per cent as compared with the last fiscal year, although bituminous materials, the most important type examined in the chemical laboratory, showed an actual increase of 10 per cent. Of the samples examined 376 were bituminous materials, 19 metal, and 31 rock, sand, cement, and miscellaneous materials.

PHYSICAL TESTS OF ROAD-BUILDING MATERIAL.

The physical laboratory tested 919 samples, a decrease of about 6 per cent as compared with the last fiscal year but well above the average annual routine testing. Of these samples 406 were rock and slag, 283 gravel, 173 sand, clay, soil, etc., 11 cement and concrete, and 46 miscellaneous. Samples were received from every State in the Union except Nebraska, Nevada, and North Dakota. The more important were as follows: Virginia, 219; Georgia, 68; Connecticut, 32; Ohio, 32; Maine, 31; Florida, 31; North Carolina, 29; Indiana, 27; Kansas, 27; West Virginia, 26; Pennsylvania, 23; and Vermont, 20. The Results of Physical Tests of Road Building Rock in 1916 was published as Department Bulletin No. 537.

MICROSCOPIC EXAMINATION AND CLASSIFICATION OF ROAD-BUILDING ROCK.

The microscopic laboratory examined and classified 681 samples of road-building material, a decrease of about 23 per cent as compared with the last fiscal year, but well above the number examined during 1915. Of these samples 415 were rock and slag, 249 gravel, sand, clay, etc., and 17 miscellaneous.

RESEARCH ON DUST PREVENTIVES AND ROAD BINDERS.

A paper upon "The Toughness of Bituminous Aggregates" was prepared for publication in the Journal of Agricultural Research. Another paper, "The Effect of Exposure on Fluid Bitumens," was presented before the American Chemical Society and will be published in the Journal of Industrial and Engineering Chemistry.

The following subjects are under investigation: The effect of variations in refining methods upon the characteristics of road oils and asphalts produced from crude petroleum; the thickness of bituminous films upon different types of rock aggregates; the effect of water upon the viscosity of road oils; relation between exposure and volatilization tests on tar products; the physical properties of coarse bituminous aggregates; the effect of colloids on bituminous materials; bituminous materials suitable for the surface treatment of waterbound gravel roads.

EXPERIMENTAL BITUMINOUS ROAD CONSTRUCTION AND MAINTENANCE.

Supervision and inspection of experimental bituminous roads has been confined largely to the vicinity of Washington, although further work was done in connection with the use of Florida coralline rock in bituminous macadam construction, and the experimental surface treatment of a gravel road in Alabama was undertaken. Continuous plant and laboratory inspection was furnished for the experimental construction of a bituminous concrete road in Virginia in which partly crushed and graded pit-run gravel was used as the mineral aggregate. The surface treatment of Virginia sand gravel and clay gravel roads with two grades of tar and a road oil was made the basis of three maintenance experiments. Plans have been made to investigate the use of screened bank gravel in the construction of bituminous gravel roads according to the penetration method. It is also hoped to continue experiments in the construction of natural soil and asphalt mixed roads in some of the Southern States.

In all of the experimental work of the year, which included the maintenance of roads constructed in previous years, this division cooperated with the Division of Construction and Maintenance. It prepared a number of road-material specifications and made 52 individual inspections. A circular summarizing the material and cost data for the construction and maintenance of all experimental roads in the vicinity of Washington was prepared for publication.

NONBITUMINOUS ROAD-MATERIAL INVESTIGATIONS.

A paper upon "Laboratory Tests of Brick Pavements" was presented before the American Society of Civil Engineers, and a new impact tester to be used in field tests of various types of roads was

designed and constructed. A paper also was presented before the American Concrete Institute upon "Friction Tests of Concrete on Various Supporting Mediums." These tests were made upon broken stone, gravel, sand clay, clay, and soil subgrades. General test limits for the physical properties of broken stone and gravel for various types of road construction were adopted as a means of indicating the value of samples examined and reported upon by the physical laboratory.

Investigations were continued on the following subjects: The relative effect of mortar and sand cushions for brick pavements; the effect of freezing and thawing upon argillaceous materials. Plans have been made for a detailed survey of quarry conditions in the United States for the purpose of securing information upon quarry practice as related to road building and of standardizing commercial sizes of broken stone to be used for that purpose.

STANDARDIZATION OF METHODS OF TESTING BITUMINOUS ROAD MATERIALS.

A paper upon "A New Consistency Tester for Viscous Liquid Bituminous Materials" was presented before the American Society for Testing Materials. This paper describes an apparatus devised by the office for accurately determining the consistency at normal temperature of road oils and tars used in the hot surface treatment of macadam and gravel roads.

Investigations were continued upon the standardization of a method of counting ultra microscopic particles in bituminous materials and the effect of controllable variables upon the float and melting-point tests. Cooperative work will be continued with the American Society for Testing Materials in connection with a number of proposed standard tests for bituminous road materials.

STANDARDIZATION OF METHODS OF TESTING NONBITUMINOUS ROAD MATERIALS.

A paper upon the "Effect of Controllable Variables upon the Toughness Test" was presented before the American Society for Testing Materials. As a result of cooperation with committee D-4 of this society a new standard toughness test and a standard method of determining the specific gravity of coarse aggregates was recommended for adoption. The office also cooperated with the Bureau of Standards and representatives of technical societies and various manufacturing industries in the development of a standard scale for laboratory sieves.

Investigations have been continued and are now in progress upon the following subjects: Improvement of the standard abrasion test for rock; the standardization of an abrasion test for gravel; a method of determining clay in aggregates; effect of controllable variables upon the hardness test.

CONCRETE INVESTIGATIONS.

The following papers were prepared for department publication or presentation before technical societies: "The Expansion and Contraction of Concrete," Department Bulletin; "Effect of Grading on Fine Aggregates for Concrete," Journal of Agricultural Research; "Tests of a Large-sized Reinforced Concrete Slab Subjected to Eccen-

tric Concentrated Loading," Journal of Agricultural Research; "The Cause of Cracks in Concrete Pavements," American Association for the Advancement of Science; "The Influences of Total Width upon the Effective Width of Concrete Slabs," American Concrete Institute; "The Flow of Concrete," American Concrete Institute.

The following investigations are in progress: Tests of reinforced concrete slabs; tests of concrete beams containing various coarse aggregates; wear measurements of experimental concrete roads; the flow of concrete having various unit stresses. In addition, it is planned to conduct investigations along the following lines: Study of concrete for its abrasive resistance; tests of reinforced-concrete floor beams; effect of freezing on changes in length of concrete.

ROAD AND BRIDGE FOUNDATION TESTS.

A soil-pressure laboratory has been constructed and put in operation at Arlington Farm. A paper upon the "Distribution of Pressure Through Earth Fills" was presented before the American Society for Testing Materials. An investigation has been started in co-operation with the Miami conservancy district upon pressures resulting from hydraulic fills, and special equipment has been installed for the necessary tests. The apparatus which was devised for measuring the distribution of pressure through fills has been perfected so as to make it thoroughly practical for both laboratory and field tests. In addition to continuing the laboratory soil-pressure investigations it is proposed to direct immediate attention to the measurement of reaction distribution under concrete pavements and foundations.

FARM-IRRIGATION INVESTIGATIONS.

UTILIZATION OF WATER IN IRRIGATION.

Experiments to determine the best methods of using water in irrigation have been carried on in cooperation with the following: State of Arizona, in the Salt River Valley; State of California and the California Agricultural Experiment Station, in Imperial and Sacramento Valleys and at the Davis farm; Colorado Agricultural Experiment Station, in the Cache la Poudre Valley; Idaho Agricultural Experiment Station, at Gooding, Idaho; and with local organizations at Twin Falls, Idaho; Kansas Agricultural Experiment Station, at Garden City; New Mexico Agricultural Experiment Station, at State College; State engineer of Nevada, and the University of Nevada, in Lamoille Valley; Oregon Agricultural Experiment Station, at Paisley and Burns; Texas Board of Water Engineers, at Mercedes and Laredo, Tex.; Utah Agricultural Experiment Station, at various points in Utah. The cooperative work in Arizona, Idaho, and Oregon was terminated during the year. Bulletins giving the results of cooperative work covering several years in the Sacramento Valley, and at the Davis farm, and a bulletin on rice irrigation in the Sacramento Valley were published by the University of California. A report of the work in Oregon was published by the Oregon Agricultural Experiment Station, and reports of the work in the other States have been prepared. A field laboratory for the study of evaporation from water and soil surfaces

is maintained at Denver, Colo., and a report of results at this laboratory has been prepared and accepted for publication in the Journal of Agricultural Research. Laboratory studies of the movement of moisture in soils have been carried on at Riverside, Cal.

PUMPING FOR IRRIGATION.

The work under this project has consisted of giving advice to farmers on the engineering features of pumping equipment; the collection of information regarding the seasonal cost of pumping; mechanical tests of pumps and pumping plants; studies of wells and well casings with reference to supplying water for irrigation; studies of the possibilities of securing a water supply by pumping in specific localities. Reports on pumping for irrigation in Kansas and Nebraska and on seasonal cost of pumping in the same territory have been prepared for publication during the year. Work under this project has been carried on in cooperation with the University of Nebraska, the University of Nevada, the New Mexico Agricultural Experiment Station, and the Texas Board of Water Engineers.

APPLIANCES AND EQUIPMENT FOR IRRIGATION.

This project includes studies and experiments for the improvement of irrigation equipment of all kinds, including dams, canals, reservoirs, structures of all kinds, and miscellaneous equipment. New and improved measuring devices have been designed and tested; a new spraying nozzle has been designed and public patent obtained; a new type of pipe for conveying water under pressure has been designed and tested; Farmers' bulletin on farm reservoirs has been prepared and published; and a report on chutes and drops is in preparation.

FLOW OF WATER IN DITCHES, PIPES, AND OTHER CONDUITS.

The work under this project consists of technical studies to work out formulas for the flow of water in the various types of conduits used to convey water for irrigation. A bulletin on flow of water in wood stave pipe has been issued; data for a similar bulletin on flow in concrete pipe have been prepared; and work on the flow in metal pipe has been begun.

MEASUREMENT OF WATER FOR IRRIGATION.

This work consists in laboratory and field experiments to develop devices for measuring water for irrigation. Laboratory experiments were carried on in cooperation with the Colorado Agricultural Experiment Station, at Fort Collins, Colo. On the basis of the experiments made, plans for two new devices have been prepared, and articles describing the devices and giving discharge formulas and tables have been published in the Journal of Agricultural Research. These devices have been installed and tested under field conditions.

CUSTOMS, REGULATIONS, AND LAWS RELATING TO IRRIGATION.

Under this project are carried on studies of the influence of customs, regulations, and laws relating to irrigation, on the success of farmers practicing irrigation, on the reclamation of arid lands by

irrigation, and on the economical use of public water supplies. Studies of the operation of irrigation districts and mutual and cooperative water companies, and public control of irrigation have been carried on.

DRAINAGE OF IRRIGATED LANDS.

All the drainage work in the West has been assigned to this division. The work consists in making surveys and plans for the drainage of agricultural land and supervising the installation of drains, experiments to determine the best methods of drainage, and studies of drainage organizations and the operation of the laws controlling drainage. There has been a large demand for assistance in drainage work in the West throughout the past year.

DRAINAGE INVESTIGATIONS.

CONSTRUCTION, OPERATION, AND MAINTENANCE OF DRAINAGE WORKS.

Extended field studies have been made of drainage ditches in the central and the southeastern States that have been in operation for several years. Experiments have been undertaken in seven districts in North Carolina, Arkansas, and Iowa, to determine the best methods and the cost of clearing drainage ditches that have become obstructed, and of keeping the ditches in effective condition. Concrete tile drains in the southeastern States are under observation.

A revision of Department Bulletin 71, "The Wet Lands of Southern Louisiana and Their Drainage," has been prepared. Manuscript for a report upon "The Cost and Operation of Drainage Pumping Plants in Louisiana" has been prepared. The study of pumping for drainage in the upper Mississippi Valley has been continued.

PEAT, TURF, AND MUCK SOILS.

An investigation was made of methods used in draining muck lands in Michigan, Wisconsin, and Minnesota. The measurements to determine the subsidence or compacting of peat and muck soils in Florida and south Louisiana, due to draining, were continued.

ORGANIZATION, FINANCING, AND LEGAL REGULATIONS OF DRAINAGE DISTRICTS.

A report upon "The Organization and Administration of Drainage Districts," explaining the means of forming drainage districts and the precautions to be observed in order to avoid litigation and to sell the bonds on the best terms, has been published.

An investigation of the methods of distributing the cost of district drainage among the beneficiaries has been begun, including a study of the laws and court decisions bearing upon the subject.

In conference with members of the legislature, the main provisions were outlined for the act that has become the general drainage law of West Virginia.

RUN-OFF INVESTIGATIONS.

An article on "Run-off from Drained Prairie Lands of Southern Louisiana," presenting the conclusions deduced from several years' study, has been prepared and accepted for publication in the Journal of Agricultural Research.

The results of two years' study of rates of run-off from drainage districts along the east coast of Florida have been compiled in a progress report prepared in mimeographed form.

The run-off studies in Tennessee were continued through the year, and measurements were made to determine friction coefficients in drainage ditches.

DRAINAGE OF TILLABLE LANDS.

The laboratory studies of capacities of tile drains being conducted on the Arlington farm, Va., have been nearly completed. Some field studies of this subject on parts of actual drainage systems have been begun.

Observation wells have been installed in tile-drained fields and in comparable undrained land on farms in North Carolina, South Carolina, Georgia, and Arkansas to determine the effects of underdrains upon the elevation of the ground-water table.

A careful field investigation was made, and Department Bulletin 512, "The Prevention of Erosion of Farm Lands by Terracing," was issued to explain the best types of terraces where terracing may be practicable. In cooperation with the College of Agriculture, terrace systems were designed as demonstrations for a few farms in Missouri and the construction supervised.

A report upon "The Drainage of Irrigated Shale Lands" has been published as Department Bulletin 502.

The investigation in the Yakima Valley, Wash., of the construction of drainage ditches and the effect upon the ground-water elevation has been completed.

A series of five lectures and five field demonstrations upon tile drainage principles and practice was given at the short course of the Georgia College of Agriculture.

Reports have been prepared and transmitted to landowners, giving detail plans and cost estimates for tile drainage and terrace systems upon just 200 farms.

OVERFLOWED LANDS.

The report embodying plans and cost estimates for protecting the bottom lands along the Kootenai River in Idaho has been completed and transmitted to the interested landowners.

A reconnaissance survey and preliminary report were made upon the drainage of overflowed lands in the Grand River Valley, Mo. Approximately 285,000 acres along the Grand River and its tributaries are subject to inundation.

A survey was made and plans prepared for the protection and drainage of about 38,800 acres subject to overflow along Clear Boggy River in southeast Oklahoma.

Using topographic and flood data available from other sources, supplemented by our own field investigations, a general plan of flood protection has been prepared for 90,000 acres of land along the Saginaw River and tributaries in Michigan.

Surveys and detail plans for drainage have been made for 7 smaller districts subject to periodical overflow; preliminary inspections and reports have been made for 17 additional areas where the landowners wished to organize drainage districts.

A report upon agricultural drainage in Georgia has been prepared for publication by the State geological survey, in cooperation with the State geologist's office.

SWAMP LANDS.

The compilation of available data upon the amount of swamp and other wet lands has been completed. According to the best information obtainable, it is estimated that there are about 71,000,000 acres of swamp land of various kinds, including tidal marsh, and 42,000,000 acres subject to overflow from streams.

A report upon storm tides along the central Gulf coast, including high-water records for the three highest of such tides, has been prepared and rather widely distributed in mimeographed form.

Surveys and drainage plans for six swamp districts have been made and reports transmitted to the interested landowners. An equal number of other similar areas have been examined and preliminary reports transmitted.

IRRIGATION IN THE HUMID REGION.

Near Vineland, N. J., experiments have been begun to test the practicability of clay tile wound with wire and laid in concrete for distributing pipes in farm irrigation plants.

RURAL ENGINEERING.

FARM DOMESTIC WATER SUPPLY AND DRAINAGE DISPOSAL.

Surveys were made and plans prepared for a gravity supply of spring water, comprising collecting works, delivery main, standpipe, and distribution system.

Drawings were made for a reinforced concrete storage tank 20 by 10 feet.

Plans were prepared for utilizing the flow of an artesian well at the kitchen sink and in a cooling tank beneath the kitchen floor.

The manuscript and about 30 drawings are nearing completion for a comprehensive bulletin on "Farm Domestic Water Systems." Methods of collecting, raising, storing, distributing, and purifying water are described and illustrated.

There was completed and published in the Yearbook (Yearbook Separate 712), the article, "Sewage Disposal on the Farm." Plans were drawn for a septic tank installation at Granville Test Farm, N. C.

Five examinations were made for the purpose of outlining systems of sewers of sewage disposal installations. One lecture was given on rural sanitation illustrated with lantern slides. Among the examinations was the Marine Corps cantonment at Quantico, Va.

Detailed information regarding the installation of sanitary methods of sewage and garbage disposal, the pumping, storing, and distributing of water as well as the development and protection of sources of water supply has been furnished to many individuals through correspondence and consultation. In some instances personal visits were made.

CONSTRUCTION OF FARM BUILDINGS.

Working drawings, and in most instances bills of materials, were prepared for the following farm structures, blue prints of which have been widely distributed:

Six-room one-story farmhouse designed to meet average farm conditions in the northern and western parts of the country. The distinctive feature of the house is the kitchen arrangement.

A community building designed for use in rural communities with an auditorium seating about 150, a large room for serving refreshments, a kitchen, dressing room, etc.

One story hollow-tile dairy barn for 20 cows.

Hollow-tile general barn for six horses, with box stalls, calf pen, feed room, harness room, and hay storage; designed for use in connection with the above dairy barn.

A dairy barn to accommodate 20 cows, with box stall, calf pen, feed room, and hay storage; designed to suit northern conditions.

Two milk houses designed for use in connecting with the above dairy barn. One of the designs includes an ice storage house.

A feeding shed for young dairy stock prepared for use with the above dairy barn.

A general barn having accommodations for four horses and four cows, with feed and hay storage.

Typical drawings for a brick silo.

Typical drawings for a wooden hoop silo.

Seven hog-house designs of various types.

Two cheese factories of 15,000-21,000 pounds and 8,000-12,000 pounds per day capacity, respectively.

A cattle-feeding shed for northern and western conditions with provision for about 50 head of cattle.

A reinforced concrete water tank of 23,500 gallons capacity.

Design for tank and silo forms.

In addition to the above designs the division completed 20 separate pieces of work for other bureaus of the department, including the drawings for buildings, laboratory equipment, and experimental apparatus.

Material assistance was given in planning the arrangement of the buildings and lots on the farmsteads of many individuals.

A representative of the division attended a farmer's short course at Ames, Iowa, delivering lectures on farmstead planning.

RURAL ENGINEERING PROBLEMS INVOLVING MECHANICAL PRINCIPLES.

A large number of requests for advice or information relative to the following subjects were given attention:

Ice-house design and construction.

Refrigeration and cooling systems for farm use.

Water supply and storage problems.

Farm electric light and power plants.

Power development from streams.

Concrete construction.

House heating.

Rural telephone lines.

Ventilation.

Gas and alcohol engines.

Windmill power.

Floating water-power plants.

Farm gates.

Care and repair of farm equipment and implements.

Power farming.

Land clearing.

Homemade farm implements.

A representative of the division made a trip through the Middle and Northwest States gathering rural-engineering data of all kinds.

A portable compressed-air spraying outfit was designed for use in experimental work to be conducted by the Bureau of Plant Industry.

Preliminary steps were taken in an investigation to be conducted jointly by this division and the Office of Farm Management to secure all available data of an economic and engineering character for the purpose of developing the use of and standardization of farm tractors.

TRACTION TESTS.

The field work of the traction tests made to determine the actual effect of road improvement on draft and width of tire was reported last year as completed except for two projects, one in North Carolina and one in Iowa. Neither of these roads has been completed, and as their condition, when completed, will not be uniform throughout the length, the results of final tests would be of little or no value in comparison with those already obtained; therefore it has been decided not to make the final tests on these roads.

An experimental dirt road was built on the Arlington Farm for the purpose of tests to determine the effect of various widths of tires on dirt roads. A preliminary report based on these tests was published as Secretary's Circular No. 72.

REPORT OF THE SOLICITOR.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SOLICITOR,
Washington, D. C., September 19, 1917.

SIR: I submit herewith report of the work of the office of the Solicitor for the fiscal year ended June 30, 1917.

Respectfully,

WM. M. WILLIAMS, *Solicitor.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

SUMMARY.

The work of this office during the fiscal year has been featured by several matters of unusual public interest, such as the drafting of the food production or survey and the food control bills, together with the legal arguments to sustain their validity; the assistance rendered in getting the Federal aid road act into operation, including framing of the rules and regulations, passing upon the questions as to whether the several States were qualified to contract with the Federal Government, and assistance rendered to the States in enacting new laws for creating State highway departments and the adjustment of existing State statutes to the underlying principles of Federal road legislation; and the assistance rendered in getting the United States grain standards act into operation, including framing of rules and regulations, and in the promulgation of standards for corn and wheat.

The United States grain standards act, the United States warehouse act, the Federal aid road act, the standard basket and container act, the Federal vocational-education act, and the United States cotton futures act, which last is a reenactment, with important amendments, of a former act of the same title, all far-reaching and important statutes, were enacted during the fiscal year. Exclusive administration of the first four and partial administration of the last two of these acts is committed to this department. The increase of the department's work in consequence of these statutes very materially added to the work of this office, as elsewhere shown in this report.

In the report for the preceding year special emphasis was laid upon the amount of assistance rendered in drafting or reporting on proposed legislation, and it was stated that more than 40 bills relating to agricultural matters were either drawn or examined and commented on. Similar work in the fiscal year covered by this report considerably exceeded in volume that of the preceding year.

Under your direction, on request of committees or Members of Congress or of State officials, 58 bills and amendments of existing statutes relating to agricultural subjects were drawn or examined and commented on. Three items of more or less extensive operation were included in an appropriation bill and became law. These three items relate to the regulation of interstate transportation of plants and plant products and stone and quarry products; regulation of the importation from Mexico of cotton and cotton seed in order to prevent the introduction or spread of the pink boll worm of cotton; and disposition of moneys received for licenses for hunting and fishing on areas set aside by the President for the protection of wild animals, birds, and fish. These three items were incorporated in the agricultural appropriation act for the fiscal year 1918, approved March 4, 1917 (39 Stat., 1134).

Other bills for the consideration of Congress, in the preparation of which aid was given, covered regulation of hunting in Alaska during the existence of the war; admission of tick-infested cattle into the United States; preparation and manufacture of viruses, serums, toxins, and analogous products for treatment of domestic animals; cotton standards; personal rural credits; carrying into effect the treaty with Great Britain for the protection of migratory birds; grant of permits for the construction of public roads over reservations for the protection of wild life; addition to the Oregon National Forest of lands reverting to the Government by virtue of railroad forfeitures; extension of time within which cutting of timber might be effected by a lumber company on one of the National Forests; river regulation and flood control; and amendments of the United States warehouse act, the food and drugs act, and the meat inspection act.

The office, either independently or in cooperation with other bureaus of the department, prepared for the consideration of State legislatures bills relating to marketing of agricultural products, cooperative agricultural credits, acceptance of the benefits of the Federal aid road act, acceptance of the benefits of the Federal vocational-education act, and for the formation of cooperative agricultural associations. In cooperation with two of the bureaus of the department a model for a city ordinance to regulate production and sale of milk was prepared.

In addition, assistance was rendered in making up the reports of the department on various Federal or State bills covering standards for fruit and vegetable baskets and containers; grain standards; part payment of salaries or compensation of Federal employees by unofficial individuals, organizations, and associations; admission of tick-infested cattle into the United States; preparation and manufacture of viruses, serums, toxins, and analogous products for treatment of domestic animals; exercise by the Supreme Court of the United States of jurisdiction in suits instituted by States against the United States in all cases where, if the issue were between individuals, it would be justiciable by the courts; grant of Federal lands to the University of Nebraska; Federal cooperation with the State of New Mexico in the destruction of predatory animals; interstate commerce in misbranded articles; the labeling of wines; and construction of public roads by States in cooperation with the United States.

At the request of committees of Congress, one of the assistants in the office orally argued before the respective committees the constitutionality of bills, prepared by the department at the request of Members of Congress, for the establishment of game sanctuaries in the National Forests and for carrying into effect the treaty with Great Britain for the protection of migratory birds.

Delays heretofore experienced in prosecuting condemnation suits for the acquisition of lands under the Weeks law, which, on account of defects in titles, could not be acquired by direct purchase, were materially reduced during the year by assistance rendered the United States attorneys by the title attorneys of this office in the preparation of petitions for condemnation and in prosecution of the suits in the courts. This assistance proved so satisfactory that arrangements were completed with the Department of Justice by which this office, after July 1, 1917, will take over the work incident to the preparation of petitions for condemnation and a large part of the court work incident to the prosecution of the cases. It is believed that this plan will materially reduce the time required for the acquisition of lands and will result in substantial benefit to the Government and persons having an interest in the litigation.

Aside from the increase in the work of the office due to the enactment by Congress of the new statutes previously referred to, the ordinary activities of the office were in the aggregate greater than in the preceding year. The increases were especially noticeable in the work connected with the contest of claims to lands in the national forests, in the number of applications for patents on inventions of department employees, and in the number of cases referred to the Department of Justice, the increase in the latter over the preceding fiscal year aggregating 1,358 cases. The only noteworthy diminution in the work of the office was in respect to the number of contracts, bonds, leases, and similar instruments prepared, there having been 493 less than in the previous year.

Law work for the Forest Service during the year, other than under the Weeks forestry law, included handling the following cases and other business:

Claims to lands.....	687	Trespasses—Continued.	
Hearings attended.....	64	Timber.....	56
Briefs prepared and filed.....	68	Fire.....	62
Depositions taken.....	97	Occupancy.....	48
Oral arguments.....	4	General litigation.....	37
Trespasses:		Written opinions.....	638
Grazing.....	117	Contracts.....	1,558

The following is a summary of the work of the office during the fiscal year in connection with the acquisition of lands under the Weeks forestry law:

Character of work.	Tracts.	Acreage.
Purchases authorized by National Forest Reservation Commission.....	240	175,463
Condemnations instructed by National Forest Reservation Commission.....	6	48,329
Agreements of purchase prepared.....	162	135,537
Titles in process of examination at beginning of year.....	40	150,873
Examinations of titles completed and reported to Department of Justice:		
Purchases recommended.....	64	192,756
Condemnations recommended.....	88	115,789
Titles conditionally approved by Attorney General and in process of adjustment.....	7	54,265
Titles in process of examination at end of year.....	56	131,977
Completion of direct purchases after approval of titles by the Attorney General.....	118	90,850
Completion of purchases of lands acquired by condemnation.....	144	149,572

Four meetings of the National Forest Reservation Commission were attended.

In addition to the 1,558 contracts prepared for the Forest Service, and the 162 purchase agreements under the Weeks law, 194 contracts, 262 leases, 25 bonds, 185 renewals, and 11 notices of termination were prepared for the several bureaus, divisions, and offices of the department, making a total of 2,397 documents of these classes.

One thousand four hundred and forty written opinions, including 638 for the Forest Service, were rendered. In addition 87 opinions upon questions arising in the administration of the United States grain standards act were prepared and distributed through service and regulatory announcements or bulletins of the Office of Markets and Rural Organization; and upwards of 200 opinions in the form of letters for the signature of the Chief of the Office of Markets and Rural Organization were prepared, revised, or approved. No account was kept of numerous informal opinions rendered, in conference and otherwise, to the various officers and bureaus of the department.

Forty-seven applications for letters patent on inventions of employees of the department for dedication to the public were prepared and filed.

Forty claims for balances due estates of employees of the department who died intestate were examined, the necessary papers prepared for their payment, and advice furnished administrative officers of the department relating to the same.

Six cases involving questions of irregularities or misconduct by employees in their official duties were reviewed. In each the facts were investigated; and in two cases formal charges were prepared after the employees concerned had had full opportunity to reply. The charges, the answers, and the evidence received consideration, and the matters were reported to you for decision. Three memoranda were prepared on general questions relating to the personnel of the department.

At the request of the Office of Markets and Rural Organization, representatives from this office accompanied representatives from that office to the principal grain markets of the United States in connection with the administration of the United States grain standards act and to various points of the Northwest to assist in the organization of cooperative work among producers of staple agricultural products.

Aid was given the advisory committee on finance and business methods in drafting a revision of the administrative regulations and various amendments of the fiscal regulations; to the Office of Markets and Rural Organization in drafting rules and regulations and forms for administration and enforcement of the United States grain standards act, the United States cotton futures act, the United States warehouse act, and the standard basket and container act, and in revising the regulations and forms of the Treasury Department under the cotton futures act; to the Office of Public Roads and Rural Engineering in the preparation of rules and regulations to carry out the Federal aid road act; to the Forest Service in drafting rules and

regulations governing hunting and fishing on lands set aside by the President for the protection of game and fish, and governing prospecting, developing, and utilizing the mineral resources of lands acquired under the Weeks forestry law, as well as numerous amendments of the regulations for the general administration of the National Forests; to the Federal Horticultural Board in drafting orders, rules and regulations, and amendments of existing regulations, for the administration and enforcement of the plant quarantine law; to the Biological Survey in drafting regulations governing entry of quail into the United States and amendments of regulations under the migratory bird law; to the Bureau of Animal Industry in drafting regulations and amendments of existing regulations governing interstate and foreign commerce in live stock and in hides, skins, and products thereof.

Many documents of various kinds, including statements of issues, briefs, and memoranda on legal matters, were prepared on behalf of the officials of this department for submission to the Attorney General, the Secretary of the Interior, the Comptroller of the Treasury, and the officials of other departments. Among the questions were whether the Reclamation Service or the Department of Agriculture has the authority to permit use for recreation purposes, of lands within a reclamation withdrawal in a National Forest not actually needed for reclamation uses; whether the Secretary of Agriculture has authority to sell timber on certain portions of the Minnesota National Forest affected with Indian claims; whether certain classes of roads are within the definition of rural post roads as defined in the Federal aid road act; whether temporary withdrawal of lands in Wyoming and certain other States can be made in aid of legislation looking to their inclusion in National Forests; whether inspection of plant products intended for importation can be made by agents of this department at the cost of the importers at points where the department does not maintain inspection; whether wrapped hams and wrapped sides of bacon are required, by the net-weight amendment of the food and drugs act, to bear a statement thereon of the net weight; the effect of certain statutes relating to military preparation on leaves of absence, pay, and reinstatement of employees of the department.

The office has been in daily conference with the officials and employees of the department with reference to legal questions arising in their work, and many letters and memoranda prepared by the various bureaus and divisions of the department, involving legal questions, have been examined and changes suggested where deemed necessary. No record was kept of these items.

A conference was held at Asheville with all the title attorneys for the purpose of discussing the problems arising in the legal work of the department connected with the acquisition of lands under the Weeks forestry law.

Violations of statutes intrusted to the department for enforcement upon which reports were made and prosecutions recommended to the Attorney General, or upon which settlements were effected without

litigation, and the amount of fines and recoveries in cases terminated and reported to this office during the year were as follows:

Law invoked.	Violations.	Fines and recoveries.	Law invoked.	Violations.	Fines and recoveries.
Laws for the protection of national forests.....	394	\$176,123.31	Lacey Act.....	40	\$1,522.00
Food and drugs act.....	1,083	19,677.50	Insecticide act.....	89	2,550.00
28-hour law.....	1,829	37,943.08	Plant-quarantine act.....	15	25.00
Animal-quarantine act.....	211	6,385.00	Miscellaneous.....	39	1,135.10
Meat-inspection law.....	271	1,790.00	Total.....	3,981	247,155.99

\$96,288.02 outstanding.

In addition, 411 decrees of condemnation and forfeiture were entered under the food and drugs act and 3 under the insecticide act.

This office investigated numerous other cases which were not reported to the Department of Justice for action because of the absence of proof of material facts or on account of other infirmities.

Evidence submitted to the office by the various bureaus of the department which disclosed apparent violations of the postal laws and regulations were referred to the Postmaster General for action.

Many memoranda on legal questions were furnished on cases reported to the Department of Justice for prosecution, and in some assistance was given in taking depositions and statements of witnesses and in the trials. Among the important cases in which this office either assisted in the preparation of briefs or in the trials, or both, were *United States v. Grand Canyon Cattle Co.* (on appeal, unreported); *Cameron v. Bass* (on appeal, unreported); *United States v. Great Northern Ry. Co. et al.* (unreported); *United States v. Swanson Bros.* (unreported); *United States v. Elk Mountain Mercantile Co.* (pending decision); *United States v. Northern Pacific Ry. Co.* (pending decision); *United States v. Utah Light & Traction Co.* (pending decision); *Emigh v. Matthews* (pending decision); *Dorsett v. Reichel* (unpublished); *St. Louis Independent Packing Co. v. Houston et al.* (on appeal, unreported); *Blanton Manufacturing Co. v. Houston et al.* (on appeal, unreported); *United States v. Union Dairy Co.* (Notice of Judgment No. 5561); *United States v. Kasper Grocery Co.* (Notice of Judgment No. 5543); *United States v. 6 Barrels of Ground Pepper* (Notice of Judgment No. 5547); *United States v. Bowers* (Notice of Judgment No. 5519); *United States v. Certain Cases of Pork and Beans* (F. and D. Nos. 7330, 7337, 7340, and 7341).

Tabulated statements showing, in detail, the facts and status of the principal prosecutions originating in the department, in which United States attorneys have commenced proceedings, and of the claims and other cases affecting the administration of the National Forests in which this office is concerned, are submitted for your information. It is recommended that these be filed for reference.

One additional law clerk was added during the last half of the fiscal year. No increase was made in the number of title attorneys. The work of the office was current at the end of the year.

Somewhat detailed statements of the principal activities of the office, without reiteration of what has been fairly covered by the foregoing summary, follow:

THE FOOD CONTROL AND THE FOOD PRODUCTION OR SURVEY BILLS.

When a state of war was recognized as existing between this country and Germany, the national food situation demanded the attention of the Congress and this department. On April 6, 1917, a resolution, Senate No. 26, was adopted by the Senate requesting the Secretary of Agriculture to immediately submit to the Senate a comprehensive plan for increasing the production of food supplies and for the creation of an organization to carry out this purpose. On April 10 an important conference, called by the Secretary, was held at St. Louis, Mo., and attended by a large number of State agricultural officials and representatives of agricultural colleges, for the purpose of discussing the agricultural situation. The conference formulated a series of recommended courses of action, many of which contemplated emergency legislation by Congress. A similar conference was held at Berkeley, Cal., on April 13. On April 18, complying with the Senate resolution, the Secretary submitted copies of the conclusions reached at these conferences, with his recommendations concerning the production and distribution of foods throughout the country and the necessary organization to carry on the work involved. At the same time this office was called upon, and immediately proceeded to analyze the conclusions reached at the conferences above mentioned, together with the Secretary's recommendations, and to draft, in the form of a bill or bills for possible introduction in Congress, such legislation as might be considered advisable to accomplish the objects in view. Many of the proposals were without legal precedent under Federal law in this country and, from the standpoint of legislative drafting, many were merely bare suggestions. Consequently an immense amount of work became necessary, first, in formulating the ideas involved in the proposed legislation and, second, in investigating and determining the legal aspects. A thorough study was made of the powers vested in Congress which might be exercised to meet the situation and, in particular, of the so-called war powers, including the effect of the various amendments to the Constitution, especially those with respect to unreasonable searches and seizures, self-incriminating evidence, and due process of law, in the light of the decisions of both Federal and State courts. In addition, the necessity of considering various administrative and economic phases of the proposed legislation also devolved upon this office. The Office of Markets and Rural Organization constantly assisted this office in the consideration of these phases of the contemplated legislation, and each proposal was carefully scrutinized and reviewed by the Secretary or his assistants. Numerous drafts were prepared, successively incorporating, adding, discarding, and re-incorporating ideas, involving the incidental, but extremely important alterations in and consideration of the meaning and effect of, the language used. This work found its substantial expression in House joint resolution 75, introduced on April 30, and bills H. R. 4036,

introduced on May 2; H. R. 4125, introduced on May 3; H. R. 4188, introduced on May 4; H. R. 4630, introduced on May 22; and H. R. 4961, introduced on June 11 by the chairman of the House Committee on Agriculture. Similar bills were also introduced in the Senate. Exhaustive consideration and debate and numerous changes by the respective committees and Houses followed, during which from time to time the Solicitor and some of his assistants attended meetings of the committees and performed various services for the House Committee on Agriculture in connection with the legislation. Briefs on the legal questions involved were submitted to the House Committee on Agriculture, one of which was directed to the legal questions respecting self-incriminating evidence and unreasonable searches and seizures arising out of the food survey provisions, and another and more extensive brief was addressed to the provisions of H. R. 4630, known as the food control bill. The latter brief presented and discussed all the constitutional questions arising out of the proposed legislation and was printed as part 10 of the hearings of the Committee on Agriculture in the House of Representatives, Sixty-fifth Congress, first session. The legislation finally enacted is that embraced in H. R. 4188 (Pub. No. 40) and H. R. 4961 (Pub. No. 41), approved on August 10, 1917, by the President, the former being commonly known as the food production or food survey bill and the latter as the food control bill.

THE FEDERAL AID ROAD ACT. (39 Stat. 355).

This act was approved July 11, 1916, and appropriates a total of \$75,000,000 for the construction and improvement of rural post roads in cooperation with the several States, and \$10,000,000 for the survey, construction and maintenance of roads and trails within or only partly within the National Forests. Rules and regulations for the administration of the act were promptly prepared in cooperation with the Office of Public Roads and Rural Engineering and the Forest Service. In order to ascertain whether each of the 48 States had a highway department within the meaning of the act and had otherwise qualified for Federal aid thereunder, examination was made of the statutes of each State. Thirty-two States were found to have highway departments as defined in the act. Sixteen either had no such departments or needed to confer additional authority upon existing organizations to give them the requisite powers. Fifteen of these States have since created highway departments or, by supplementary legislation, have conferred appropriate powers upon existing organizations. At the request of six of the States this office cooperated with the Office of Public Roads and Rural Engineering in preparing bills for enactment by the States to enable them to participate in the benefits of the act. Pending road legislation in 18 States was critically examined and suggestions made, where necessary, for amendment. The office drafted a form of bill for enactment by many of the States to enable them to comply with that provision of the act which requires the assent of each State to its provisions. In addition, proposed assenting acts of a number of States were reviewed to ascertain whether they were sufficient. Upon request, proclamations were drafted to enable several States, through their governors, to accept

the provisions of the act pending action by their legislatures. Many inquiries regarding proposed road legislation in the States were answered. Fifty road-project statements submitted by the States were examined, and 10 agreements for the construction of roads were prepared. Various forms were drafted for use by the States in the administration of the act.

UNITED STATES GRAIN STANDARDS ACT. (39 U. S. Stat. 432).

The appropriation act for this department for the year ending June 30, 1917, which was approved on August 11, 1916, contained a part known as the United States grain standards act, which provides for the establishment of official grain standards of the United States for corn, wheat, and other grains and of a system of licensed inspection and grading thereunder for the purposes of interstate and foreign commerce. This statute was the result of an agitation extending over a number of years looking to the elimination of the diverse standards and systems of grading thereunder in use in the various grain markets and to the substitution therefor of uniform standards and their accurate application throughout the United States.

Immediately upon the passage of the act this office worked with representatives of the Office of Markets and Rural Organization in the preparation of orders of establishment and promulgation, including the description, of the official grain standards of the United States for shelled corn, which were issued on September 1, 1916, effective December 1, 1916. Following this the preparation of rules and regulations under the act was taken up. A series of conferences with members of the trade and public hearings on the proposed regulations were attended and the final draft was completed and was issued on November 6, 1916. In the meantime and following the issuance of the regulations forms were prepared for grade memoranda, findings, complaints, stipulations, and authority of agents, in both disputes and appeals, certificates of grade, applications for inspectors' licenses, orders of cancellation of licenses, daily records and monthly reports of licensed inspectors, handling of fees and charges, shippers' reports of uninspected grain, a tabulation of the shelled-corn standards, and other papers and records used in the administration of the act. Assistance was also given the Office of Markets and Rural Organization in framing the order of the Secretary of Agriculture establishing supervision districts for use in administering the act. During the year 87 opinions upon questions arising in the administration of the act were prepared and distributed through service and regulatory announcements and information bulletins of the Office of Markets and Rural Organization and upwards of 200 others in the form of letters, not published, for the signature of the chief of that office were prepared, revised, or approved. This office participated in the preparation of proposed standards for wheat, upon which public hearings, attended by a representative of this office, were held in various markets of the United States during February and March, 1917. These standards were then put into final shape and were issued on March 31, 1917, effective in part on July 1 and in part on August 1, 1917. A

variety of other services was rendered during the fiscal year. Papers and the findings of the Secretary of Agriculture in 289 appeals and 1 dispute involving the grading of shelled corn under the act were reviewed. Eighty-nine forms of inspection certificates submitted by licensed inspectors were examined and passed upon. Nine service and regulatory announcements and 16 information bulletins of the Office of Markets and Rural Organization were examined and changes suggested when necessary. The laws of 9 States were considered with reference to questions arising under the act, particularly as to the status of applicants in such States for licenses as inspectors. Aid was furnished in the preparation of the first semi-annual publication, required by the act, of certain facts reported by licensed inspectors and furnished by grain warehousemen. A special study and a report were made, in cooperation with a specialist of the Office of Markets and Rural Organization, of the handling and inspection of sacked grain in four markets. Numerous conferences were attended in Washington with members of the trade and with the Office of Markets and Rural Organization, and also with newly appointed grain supervisors, for the purpose of preparing them for their duties. During the course of the year, in connection with the administration of the act, representatives of this office visited 30 cities, eight of which were visited twice and two, 3 times.

The close cooperation extended to this office by the Office of Markets and Rural Organization was an important factor in promoting the efficiency of this office in carrying on its part of the work.

THE NATIONAL FORESTS.

LAND CLAIMS.

Six hundred and eighty-seven cases, involving about 166,855 acres of land claimed under the homestead, timber and stone, mineral, lieu and railroad selection, and other general and special land laws of the United States, were handled.

One hundred and eighty-eight decisions were rendered, including those of registers and receivers and the Commissioner of the General Land Office, subject, respectively, to review by the commissioner and the Secretary of the Interior. The registers and receivers decided 41 cases for and 32 against the Government. The commissioner decided 64 cases for and 23 against the Government, and the Secretary decided 29 for and 7 against the Government. Of the 188 cases, 139 were closed during the year, 86 by decisions for and 27 against the Government, 9 by voluntary withdrawal of Forest Service protests, 4 by withdrawal of final proof after protest by the Forest Service, 5 by cancellation of the entry in part, 5 by relinquishments after protest by the Forest Service, 2 upon elimination of the land from the forest, and 1 upon a finding that the land was outside of the forest. As a result of the 84 decisions for the Government, approximately 11,573 acres of land, supporting a stand of more than 302,574,000 feet of timber, valued at more than \$686,736, were retained in the National Forests.

The remaining 548 cases received attention varying in degree with their progress in the Forest Service and in the Department of the Interior.

Hearings were attended in 61 cases. Oral arguments were made before the Secretary of the Interior in 4 cases. Depositions were taken in 97 cases. Briefs were filed in 68 cases. One motion for rehearing and 1 petition for the exercise of supervisory authority were filed with supporting briefs. Appeals to the Secretary of the Interior, supported by briefs in 4 cases, were prosecuted from the adverse decisions of the commissioner. Six reply briefs were filed with the Secretary of the Interior.

The assistants to the solicitor in the field examined and passed upon the evidence in many cases in which either they prepared protests to be filed in the local land offices by the district foresters or recommended that no objection be made to the issuance of patent.

IMPORTANT DECISIONS OF THE INTERIOR DEPARTMENT.

In *United States v. J. P. Nichols and Cy Smith* (46 L. D. —), the Secretary of the Interior, in response to a motion for rehearing filed by this office, reversed his decision of October 24, 1913, and held that the Land Department has full power to inquire into the validity of a mining claim, notwithstanding that the claimant has not invoked its jurisdiction by any application for patent. To the same effect are decisions of the United States District Court for Arizona and the Court of Appeals of the District of Columbia in suits filed by R. H. Cameron, one against the register and receiver of the local land office (*Cameron v. Weedon and Birdno*, 226 Fed. 44) and the other against the Secretary of the Interior and the Commissioner of the General Land Office (*Cameron v. Lane et al.*, 46 App. D. C. —) to restrain them from conducting proceedings instituted to determine the validity of certain mining locations made by him on lands within the Tusayan National Forest and Grand Canyon National Monument.

As a result of the decision in the Nichols-Smith case, adverse proceedings have been instituted against a number of similar mining claims within the National Forests.

In *Ex parte Samuel D. Pulford et al.* (45 L. D. 494) the Secretary of the Interior dismissed the appeal of the claimants from the decision of the Commissioner of the General Land Office, holding invalid certain claims filed by them under the coal-land laws for lands within the Siskiyou National Forest. The lands are very heavily timbered, but had been classified by the Geological Survey as coal land and valued at \$10 per acre. The Forest Service estimated the timber to be worth about \$60 to \$70 per acre. The Secretary of the Interior held that since workable deposits of coal had not been disclosed the claimants were not entitled to a patent.

In *State of Utah* (45 L. D. 620) it was held that the fact that the State may select saline lands as well as agricultural lands in satisfaction of the grant of lands made to it by Congress for the University of Utah (sec. 8, act July 16, 1894, 28 Stat., 107-109) does not entitle it to select lands of that character within a National Forest. It was also held, in accordance with a similar decision with reference to the State of Idaho (*Erwin v. Idaho*, 38 L. D. 219), that the preference right of selection given to a State upon its application for

withdrawal and survey of a certain area (act of Aug. 18, 1894, 28 Stat. 394) will not prevent the inclusion of the lands within a National Forest.

In *Washington v. Lynam* (45 L. D. 593) it was held that school sections included within a National Forest in the State of Washington prior to survey are to be administered in all respects as are other lands within the forest, since the State gets no title until the lands are surveyed, and a withdrawal prior to survey defeats its title so long as the forest is maintained.

In *William H. Whitten* (45 L. D. 542) it was held that upon cancellation of patent for lands within a National Forest the title of the United States relates back to the date when it was conveyed to the patentee, and that the land therefore becomes a part of the forest. It was further held that in view of the fraud in procuring the patent the equitable title remained in the United States, and the forest withdrawal operated upon this as well as upon the legal rights of the United States.

TRESPASS.

Damages and fines recovered during the year for trespasses upon the National Forests were:

Class of trespass.	Damages.	Fines.
Grazing.....	\$5,910.30	\$319.00
Timber.....	22,332.51	80.00
Fire.....	77,676.25	87.50
Occupancy.....	68,573.25	10.00
Miscellaneous fines and recoveries.....		1,134.00
Total.....	174,492.31	1,630.50

\$96,288.02 outstanding.

In addition, 48 cases of illegal occupancy were handled during the year, involving the unauthorized use of land for various purposes. They were dealt with mainly by the institution of injunction proceedings or settlement without recourse to the courts. In 3 cases the Supreme Court affirmed decrees of the lower court enjoining the use without permit of forest lands for the development of hydroelectric power, but reversed these decrees to the extent that they denied the Government's right to compensation for past occupancy and use. Injunctions were granted in 5 cases in favor of the Government. A decree canceling patent was rendered in one case, and in another a decree clearing the Government's title. Judgments for possession were entered in 4 cases. Three bills filed by the Government were dismissed, but appeals have been taken. The remainder, except one which was settled, were pending in various stages at the close of the year.

GENERAL LITIGATION.

Thirty-seven cases not referable to any of the above classes were handled. Among these were 8 involving questions of water rights. Two cases involving personation of forest officers resulted in a fine of \$25 in one and a jail sentence of 13 months in the other, together

with costs of \$20 (approximate) and \$72.65, respectively. In one case of perjury in connection with a hearing in a public land case the defendant was fined \$50. Two defendants were fined \$5 and \$10, respectively, for disorderly conduct on camping grounds within a forest. Two mining claimants were fined \$5 each for using their claims for other than mining purposes in violation of the National Forest regulations and were admonished that jail sentences would be imposed for repetition of the offenses. A temporary injunction against draining a water hole was granted pending the Interior Department's adjudication of the defendant's settlement claim embracing it. A prosecution for embezzlement was dismissed on a showing that defendant could not be found and that his sister had reimbursed the Government in full. A prosecution for forgery resulted in the acquittal of the defendant. An action for damages on account of failure to complete a timber sale contract resulted in a default judgment for damages, interest, and costs. A petition for reduction in logging rates affecting National Forest timber is pending before the Interstate Commerce Commission.

COURT DECISIONS OF INTEREST.

The decision by the Supreme Court in *Utah Power & Light Co. v. United States* (243 U. S., 389) brings to a successful termination a controversy of several years' duration with respect to the right of hydro-electric power companies, without permission from the Secretary of Agriculture, to occupy and use lands of the United States within the National Forests for the generation and distribution of hydro-electric power. The court upheld the Government's contention that the lands may be held for such purposes only under revocable permits issued by the Secretary under the provisions of the act of February 15, 1901 (31 Stat., 790). The company claimed the right, under earlier acts of Congress and the laws of Utah, to occupy and use certain lands in the Cache National Forest without permits. The court held that Congress has the exclusive power to regulate the use of, and prescribe the conditions under which rights may be acquired in, lands of the United States, and that State laws, including those relating to the exercise of the power of eminent domain, have no application to such lands. Under the decision the Government is entitled to reasonable remuneration for the occupancy and use of the land. The decree of the lower court, enjoining the company from maintaining and operating its works, was affirmed. The decision was also determinative of the similar cases of *Beaver River Power Co. v. United States*, and *Nunn et al. v. United States*. As a result of this decision the suit instituted in California by the *Pacific Gas & Electric Co. v. David F. Houston et al.*, praying for an injunction against any interference with an alleged right to construct, without a permit from this department, a ditch across certain lands of the United States within the Eldorado National Forest for the purpose of developing electrical power, was dismissed.

That railroad companies may acquire rights of way over National Forests only with the approval of the Secretary of the Interior, and under such conditions and restrictions as may be deemed necessary for the protection of the forest, was settled by the decision of the

Supreme Court in *Chicago, Milwaukee and St. Paul Railway Co. v. United States* (244 U. S. 351), in which, also, the Government was awarded \$68,000 for timber cut and destroyed, and other damage caused, by the company in constructing its road.

In *United States v. Great Northern Railway Co., Winston Bros. Co. and C. W. Werdenhoff*, involving a fire trespass on the Flathead and Lewis and Clark National Forests, the jury rendered a verdict of \$50,000 and costs in favor of the United States, which the defendants have paid.

In *Cameron v. Lane and Tallman* (46 App. D. C., —) the Court of Appeals of the District of Columbia held that the Secretary of the Interior has ample power of his own motion prior to application for patent to inquire into the validity of a mining claim. The case was pending in the Supreme Court of the United States on appeal at the close of the year.

In *United States v. Swan Hoglund* (244 U. S., 174) the Supreme Court held that the United States is bound by the proviso of section 7 of the act of March 3, 1891 (26 Stat., 1095), which limits to two years after the issuance of receiver's final receipt the time within which a protest or contest may be instituted against an entry of public lands made under the homestead, desert land, and certain other land laws of the United States. The fact that Hoglund's homestead entry was subsequently included within a National Forest was held to be immaterial, even though he was not complying with the law at the time the forest withdrawal was made.

In *California v. Deseret Water, Oil and Irrigation Co.* (243 U. S., 415) the Supreme Court held that where school sections previously surveyed are included within a National Forest, the State may waive its rights thereto and select other lands in lieu thereof under the provisions of sections 2275 and 2276 of the Revised Statutes, as amended by the act of March 3, 1891 (26 Stat., 796). The court approved the Land Department's construction of the law, with which the decisions of several of the lower courts were in conflict.

In *United States v. N. J. and B. A. Cameron* the defendants were each fined by the United States District Court for Arizona for conducting a livery business upon a mining claim within the Tusayan National Forest and Grand Canyon National Monument in violation of the department's regulations requiring a permit for any use of an unpatented mining claim other than for mining.

In *United States v. R. H. Cameron* an injunction was granted by the United States District Court for Arizona against the continued occupancy and use of a canceled mining location within the Tusayan National Forest and Grand Canyon National Monument and the making of any excavations other than for annual assessment work. Defendants were also ordered to remove all buildings and structures and all deposits of filth, manure, and refuse. An appeal having been taken, the injunction was modified to permit the maintenance of the buildings pending decision on the appeal.

In *United States v. Arthur Harvey* the United States District Court for South Dakota enjoined the defendant from maintaining a fence upon, and using for pasture and agricultural purposes, certain land in the Black Hills National Forest claimed under a mining location. It was ordered that the fence be forthwith removed. The defendant's application for a patent had previously been rejected

by the Secretary of the Interior and the location declared null and void.

In *United States v. Nels Swanson*, a suit for the condemnation of a right of way for a wagon road over lands of the defendant, the United States District Court for the Northern District of California held that the appropriation made by the agricultural appropriation act of June 30, 1915 (38 Stat., 786, 1100), "for the construction and maintenance of roads, trails, * * * and other improvements necessary for the proper and economical administration, protection, and development of the National Forests," authorized the Secretary of Agriculture to acquire lands for roads and highways within the National Forests.

In *Northern Pacific Railway Co. v. Lane* (46 Appeals D. C., —), the Court of Appeals of the District of Columbia affirmed the decision of the Supreme Court of the District, refusing to restrain the Secretary of the Interior from canceling a list of indemnity selections made by the railroad company for lands within a National Forest. It was held that the company has no right of selection until the lands are surveyed, and that even though it had been previously determined by the Land Department that the indemnity lands were insufficient to satisfy the company's losses, a withdrawal of the lands for forest purposes prior to survey defeated the company's right of selection.

IMPORTANT OPINIONS OF THE ATTORNEY GENERAL.

A question having arisen with respect to the relative powers of the Secretary of the Interior and the Secretary of Agriculture in the administration of the Minnesota National Forest, created by the act of Congress approved May 23, 1908 (35 Stat., 268), the matter was referred to the Attorney General, who advised, on January 24, 1917, that the Secretary of Agriculture has authority to administer the forest in all respects as other National Forests are administered, subject, however, to timber sale contracts made by the Secretary of the Interior pursuant to the statute and to the condition that receipts from sales of other timber prior to the appraisal thereof required by the statute shall be deposited to the credit of the fund for the Indians.

With regard to the administration of National Forest lands withdrawn for reclamation purposes, the Attorney General on November 28, 1916, advised that the Reclamation Service is without legal authority to lease to private parties for recreation and other purposes lands not actually needed for reclamation uses, such as those located along the shores of reservoirs constructed by that service.

In an opinion of November 28, 1916, the Attorney General advised that in Wyoming and other States in which the enlargement of National Forests, except by act of Congress, is prohibited by the act of March 4, 1907 (34 Stat., 1271), withdrawals of land in aid of legislation looking to their inclusion within National Forests may be made notwithstanding the reiteration in the withdrawal act of June 25, 1910 (36 Stat., 847), and the amendatory act of August 24, 1912 (37 Stat., 497), of the prohibition contained in the act of 1907.

In an opinion of August 24, 1916, the Attorney General advised that a corporation, organized and existing under and by virtue of

the laws of the Province of Manitoba, Canada, is not a qualified applicant for a permit under the provisions of the act of February 15, 1901 (31 Stat., 790), or a grant under the act of February 1, 1905 (33 Stat., 628), for a right of way within the Washington National Forest for use in connection with the development of hydro-electric power in connection with the operation of mining claims held by it.

THE PLANT QUARANTINE ACT (37 Stat. 315).

Fifteen cases were reported to the Attorney General, 14 of which are pending, one having been closed on payment of a fine of \$25. Nine cases pending at the close of the fiscal year 1916 have not been disposed of, making a total of 23 cases now pending in various stages of prosecution.

A number of proposed orders of the Secretary of Agriculture to establish, and of regulations to enforce, quarantines under the law were examined as to their legal form and sufficiency.

At the request of the Federal Horticultural Board there was drafted, for inclusion in the appropriation bill for the fiscal year 1918, an item for an emergency appropriation on account of the existence of the pink boll worm of cotton in Mexico, and conferring upon the Secretary authority to take necessary action to prevent the introduction thereof into the United States and to stamp out any infestation that may be found in the United States on account of the shipment of 500 carloads of cotton seed into Texas. A proposed amendment to section 8 of the plant quarantine act was drafted, and later enacted by Congress, to eliminate the necessity of a finding by the Secretary as a condition precedent to a quarantine of any State that a dangerous plant disease or insect infestation exists therein, and also to confer additional authority with regard to quarantine on account of the gypsy and brown-tail moths.

COURT DECISION OF INTEREST.

In *Daigle v. United States* (237 Fed. 159), involving a shipment of 22 barrels of potatoes from Daigle Island, in the St. John River, within the Dominion of Canada, to Fort Kent, Me., in violation of the quarantine promulgated by the department on December 22, 1913, against the importation of potatoes from the Dominion of Canada, Newfoundland, and other countries, because affected with potato disease, it was held by the Circuit Court of Appeals that since they were imported contrary to law the potatoes, as well as the vehicles and animals used in transporting them, were subject to forfeiture.

THE FEDERAL VOCATIONAL-EDUCATION ACT (39 Stat. 929).

In response to your request, as a member of the Federal Board for Vocational Education, created by the act of Congress, approved February 23, 1917, known as the Federal vocational-education act, there was drafted for transmission to the governors of the several States, a suggested bill, with alternate clauses to meet varying conditions, for enactment by any State, accepting the provisions of the

act. In response to requests from two different sources, a special bill was prepared for one State. At the request of the governors of three of the States, proclamations were prepared for their use in accepting the provisions of the act, pending action by the legislatures of their States. Statutes passed by 13 of the States accepting the provisions of the act were reviewed and opinions expressed as to their sufficiency. Replies to a number of letters of inquiry regarding the law were drafted for your signature.

THE WEEKS FORESTRY LAW (36 Stat. 961).

Although during more than half of the year the number of title attorneys engaged upon the examination of titles to lands proposed to be acquired under the Weeks forestry law was smaller than in the preceding fiscal year, the number of titles examined and the acreage acquired were not substantially less than in the preceding year.

The National Forest Reservation Commission, in addition to establishing new purchase areas in Lawrence and Winston Counties, Ala., and in Coos County, N. H., authorized the purchase of 175,463 acres of land. The work incident to obtaining copies of grants affecting lands to be acquired in the new purchase areas from Federal and State records was completed during the year. The department requested the Attorney General to institute condemnation proceedings for the acquirement of 48,329 acres in the States of New Hampshire, North Carolina, and Georgia.

The following is a summary, in terms of acres, of operations under the Weeks law from the beginning to June 30, 1917:

State and area.	Purchases authorized (estimated).	Purchases completed (actual survey).	Reports in Department of Justice.	
			For opinion (actual survey).	For condemnation (actual survey).
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
Alabama: Alabama.....	22, 112		1, 601. 10	
Georgia:				
Georgia.....	62, 904	20, 881. 42		7, 079. 36
Savannah (S).....	47, 731	17, 256. 27		8, 366. 93
Maine: White Mountain.....	27, 733		413. 32	
New Hampshire:				
Kilkenny.....	36, 290			
White Mountain.....	312, 614	45, 951. 53		33, 299. 40
North Carolina:				
Boone.....	42, 494	311. 97	579. 79	39, 061. 41
Mount Mitchell.....	85, 972	19, 492. 64	395. 64	5, 842. 07
Nantahala.....	40, 252	1, 670. 38	231. 29	850. 06
Pisgah.....	94, 588	4, 105. 94	14, 819. 63	
Savannah (N).....	41, 196	14, 536. 68		2, 310. 68
South Carolina: Savannah (S).....	26, 253	3, 878. 76		14, 189. 83
Tennessee:				
Cherokee.....	141, 937	8, 549. 44	5, 986. 65	2, 978. 33
Smoky Mountain.....	117, 113			
White Top.....	68, 039	12, 977. 69	338. 68	10, 389. 56
Unaka.....	49, 949	11, 497. 01	44. 02	26, 785. 48
Virginia:				
Massanutten.....	67, 761	14, 665. 13	2, 071. 86	13, 905. 89
Natural Bridge.....	95, 800	37, 293. 92	343. 51	1, 644. 58
Potomac.....	62, 454	2, 157. 37		10, 680. 86
Shenandoah.....	125, 547	1, 933. 54	656. 72	17, 985. 93
West Virginia:				
Monongahela.....	54, 464	20, 896. 72	1, 100. 17	
Potomac.....	17, 075	2, 166. 29	871. 81	478. 25
Shenandoah.....				

THE FOOD AND DRUGS ACT (34 Stat. 768).

Seven hundred and eighty-two cases were transmitted to the Department of Justice, in 424 of which criminal proceedings and in 358 of which seizures were recommended. The 424 criminal cases embraced 735 alleged violations of the food and drugs act.

At the close of the fiscal year 1916, 377 cases were pending, of which 200 were criminal prosecutions and 177 were seizures.

Two hundred and ninety-two cases pending at the close of the fiscal year 1916 and 555 reported during the fiscal year 1917, in all 847, were terminated in 1917. Of those terminated 412 were criminal and 435 were civil.

In 340 of the 412 criminal cases fines were imposed, the fine being the costs of the proceeding in 1 case; in 1 an appeal taken by a defendant was dismissed; in 1 the court refused leave to file the information; in 4 sentence was suspended; in 1 a demurrer to the indictment was sustained, and the case is now pending in the Supreme Court of the United States on the Government's writ of error; in 6 there were acquittals; 20 were nol prossed; and 39 were withdrawn, dismissed, or barred by the statute of limitations. In a majority of the cases in which fines were imposed pleas of guilty, nolo contendere, or non vult were entered. In 14 pleas of not guilty were entered, and the defendants were convicted after trial, and in 1 of these the judgment of conviction of the lower court was affirmed.

In the criminal cases in which convictions were obtained the fines were as follows:

Number of cases.	Amount of fine.	Total.	Number of cases.	Amount of fine.	Total.
1.....	Costs.	.....	1.....	\$95.00	\$95.00
1.....	\$2.00	\$2.00	27.....	100.00	2,700.00
26.....	5.00	130.00	1.....	110.00	110.00
1.....	6.00	6.00	1.....	135.00	135.00
37.....	10.00	370.00	1.....	140.00	140.00
1.....	12.50	12.50	8.....	150.00	1,200.00
4.....	15.00	60.00	1.....	180.00	180.00
23.....	20.00	460.00	1.....	199.00	199.00
82.....	25.00	2,050.00	13.....	200.00	2,600.00
8.....	30.00	240.00	4.....	250.00	1,000.00
2.....	35.00	70.00	1.....	275.00	275.00
9.....	40.00	360.00	1.....	280.00	280.00
2.....	45.00	90.00	3.....	300.00	900.00
66.....	50.00	3,300.00	1.....	398.00	398.00
2.....	55.00	110.00	1.....	500.00	500.00
1.....	60.00	60.00	2.....	600.00	1,200.00
1.....	70.00	70.00			
5.....	75.00	375.00	339.....	.....	19,677.50

In addition to the fines imposed, costs were generally assessed.

Of the 435 civil cases terminated during the year, decrees of condemnation and forfeiture were entered in 411, of which 7 were decided favorably to the Government after contest; in 3 the libels were dismissed; in 21 the packages were broken or disposed of before seizure could be made. In the 411 cases in which decrees of condemnation and forfeiture were entered the goods were destroyed in 201, released on bond or otherwise in 196, and sold in 14. In many of the cases in which the product was released, the decree of the court provided that the product should be sorted and that that portion found unfit for food should be destroyed.

At the close of the year 313 cases were pending, of which 213 were criminal prosecutions and 100 were seizures.

In addition to the cases reported by this department to the Department of Justice the food and drugs officials of the various States and of the District of Columbia, collaborating with the department in the enforcement of the act, reported 29 cases to the United States attorneys for action. Of these, 15 were criminal cases and 14 were seizures. In all of the criminal cases there were convictions. In all of the seizure cases decrees were entered and the products either released on bond or sold. Decrees were entered in three cases reported prior to this fiscal year and the products released on bond. The fines in the criminal cases were as follows:

Number of cases.	Amount of fines.	Total.
3	\$10	\$30
2	15	30
1	20	20
7	25	175
1	40	40
1	-----	-----
15	-----	295

¹ Released on personal bond.

Five hundred notices of judgment were published during the year.

CASES OF INTEREST.

In *Simpson v. United States* (241 Fed. 841; Cir. 88, Office of the Solicitor) the defendant, trading as The C. M. Simpson Medical Institute of Cleveland, Ohio, was convicted, after a plea of not guilty, in the District Court for the Northern District of Ohio. The offense consisted in the shipment from Ohio to Minnesota of a medicinal compound designated "Simpson's Cerebro-Spinal Nerve Compound," which contained on the label of the package and an accompanying circular certain statements regarding the therapeutic and curative effects of the article, which were alleged to be false and fraudulent. On appeal to the circuit court of appeals, it was held that unless an information is void an objection that it was not made on the oath of the prosecuting officer but solely upon the oaths of witnesses by affidavits, some of which were taken before notaries public, could not be raised for the first time on appeal unless a refusal to consider it would shock the judicial conscience; that such objection was purely technical and was waived by pleading to the information without protest. The court also held that in charging the interstate shipment by defendant of a medicinal compound designated by his own name on the labels and in the accompanying circular, which label and circular contained statements regarding the therapeutic efficacy of the compound which were false and fraudulent in that they were applied to such article knowingly and in reckless and wanton disregard of their truth or falsity, the information substantially averred the defendant's knowledge and reckless and wanton disregard of the truth or falsity of these therapeutic claims; that, consequently, the fraud, a necessary element in the

offense attempted to be charged, was substantially pleaded. It was further held that allegations to the effect that the shipment consisted of certain packages, that the packages contained the circular or pamphlets described, and that one of the representations was contained on the label and the other was included in said circular were sufficient to charge that the misrepresentations in question were intended to accompany the bottles containing this drug product into the hands of the consumer.

Discussing the term "remedy" upon the labels of drug products, the court expressed the view that the term "remedy" implied a curative tendency though not guaranteeing a cure.

In *United States v. Watson-Durand-Kasper Grocery Co.* (N. J. No. 5543), tried by the United States District Court for the District of Kansas without a jury on an agreed statement of facts, which showed that the defendant shipped in interstate commerce 250 pails of candy of several varieties under two distinct billings, it was alleged in the information that the candy was adulterated in that it consisted in whole or in part of a filthy, decomposed, and putrid vegetable substance. The court held, on the authority of *B. & O. S. W. R. R. v. United States* (220 U. S., 94), that the shipment in this case of the divers articles of confectionery under different billings constituted but one offense under the food and drugs act. The court held, further, that the defendant was guilty of shipping an article adulterated under the provisions of section 7 relating to confectionary, holding in this connection that the phrase "or other ingredient deleterious or detrimental to health" in the provisions mentioned was not limited or restricted by the preceding phrase "or other mineral substance or poisonous substance or flavor." In the opinion of the court it was the intent of the law-making power to provide that confectionery might be adulterated in violation of the terms of the act in three distinct and separate ways:

(1) By causing it to contain terra alba, barytes, talc, chrome yellow, or other mineral substance or poisonous color or flavor.

(2) By permitting it to contain or include any "other ingredient deleterious or detrimental to health."

(3) By the use of "any vinous, malt, or spirituous liquor or compound or narcotic drug."

In *United States v. Joseph L. Schider et al.* (unreported F. and D. No. 7805), the United States District Court for the Southern District of New York sustained a demurrer to an indictment charging adulteration and misbranding of an article labeled "Compound ess grape," upon the authority of *Weeks v. United States* (224 Fed., 64), relating to the labeling of compounds. The case is pending in the Supreme Court on the Government's writ of error.

In *United States v. Natura Co.* (N. J. No. 5552), tried in the Northern District of California, the court, in rejecting the Government's contentions relative to misbranding under the Sherley amendment to the food and drugs act of an article called "Akoz," held that "it could not be concluded that when the defendant used the word 'remedy' it used it as synonymous with 'cure,' nor can it be concluded that the word would be accepted by the public to mean cure."

In *United States v. 6 Barrels of Ground Pepper* (N. J. No. 5547), where quinine alkaloid had been used by the Government as a marker for the detection of the presence of added pepper shells in the prod-

uct, the court held that it was not incumbent on the Government to show the absence of any reasonable possibility of quinine alkaloid finding its way into the pepper in any other manner than by the addition of the pepper shells into which it had been placed as a marker, and that the presence of the quinine alkaloid in the pepper was sufficient proof of the addition of the alkaloid-treated shells to the pepper.

Among other cases of interest were the following:

United States v. A. Koshland (N. J. No. 5246).

United States v. Atlantic Macaroni Co. (N. J. No. 5521).

United States v. 5060 Cans of Tomato Pulp (N. J. No. 5527).

United States v. Pulmonol Chemical Co. (N. J. No. 5535).

United States v. 9 Barrels of Butter (N. J. No. 5375).

United States v. Certain Bags Rape Seed (F. and D. Nos. 7501, 7502, and 7503, unreported).

United States v. Certain Cases Pork and Beans (N. J. No. 5059).

United States v. Russian Monopol Co. (N. J. 5542).

THE MEAT-INSPECTION LAW (34 Stat. 674).

Two hundred and seventy-one cases were reported to the Attorney General during the fiscal year, while 237 cases were reported during the preceding year, an increase of 34 cases for the fiscal year 1917.

At the close of the fiscal year 1916, 92 cases were pending.

Of the cases reported during the fiscal year 1917, 60, and of those pending at the close of the fiscal year 1916, 59, in all 119, were terminated during the year 1917. One hundred resulted in conviction, 7 were dismissed, and in 12 grand juries failed to indict.

Fines aggregating \$1,790 were imposed in 100 cases, as follows:

Penalty.	Number of cases.	Total fines.	Penalty.	Number of cases.	Total fines.
\$5 ¹	3	\$15	\$30.....	2	\$60
10.....	8	80	50.....	6	300
15.....	4	60	100.....	4	400
20.....	5	100			
25 ²	31	775		63	1,790

¹ 2 cases were consolidated into 1 and a fine of \$5 imposed.

² In one instance 16 cases were consolidated into 1 and a fine of \$25 imposed; in another instance 21 cases were consolidated into 1 and a like fine imposed; in another instance 2 cases were consolidated into 1 and a like fine imposed.

At the close of the year 244 cases were pending.

THE TWENTY-EGHT HOUR LAW (34 Stat. 607).

One thousand eight hundred and twenty-nine cases were reported to the Attorney General. This is an increase over the preceding year of 1,364 cases and 284 in excess of the number reported during any previous fiscal year.

At the close of the fiscal year 1916, 1,085 cases were pending.

Of the cases reported during the fiscal year 1917, 258, and of those pending at the close of the fiscal year 1916, 138, in all 396, were terminated during 1917.

Penalties aggregating \$37,948.08 were recovered in 332 cases. Forty-eight cases were dismissed and 16 were determined adversely to the Government.

The following is a detailed list of the number of cases prosecuted and amounts of penalties assessed:

Number of cases.	Amount of penalty.	Total.	Number of cases.	Amount of penalty.	Total.
274.....	\$100	\$25,800.00	1.....	\$185.00	\$185.00
21.....	200	4,200.00	1.....	175.00	175.00
10.....	250	2,500.00	2.....	375.00	375.00
7.....	150	1,050.00	2.....	250.00	250.00
5.....	300	1,500.00	3.....	138.08	138.08
3.....	125	375.00			
2.....	500	1,000.00	332.....		37,948.08
1.....	400	400.00			

Two thousand five hundred and eighteen cases were pending at the close of the fiscal year.

CASES OF INTEREST.

Among the cases of interest decided during the year were:

Southern Pacific Co. v. Stewart (233 Fed. 956).

United States v. Chicago, Milwaukee & St. Paul Railway Co. (234 Fed. 386).

United States v. Sioux City Terminal Railway Co. (234 Fed. 663).

United States v. Philadelphia & Reading Railway Co. (238 Fed. 428).

During the year conferences were held between representatives of the Department of Justice, the Grand Trunk, Erie, and Michigan Central Railroad Companies, and of this department, with a view to the settlement of a large number of cases against the respective companies. No final settlements have as yet been made, but it is believed that action to that end will soon be taken.

ACTS REGULATING THE INTERSTATE MOVEMENT OF LIVE STOCK FROM QUARANTINED DISTRICTS, PROHIBITING THE INTERSTATE MOVEMENT OF DISEASED LIVE STOCK, AND PROHIBITING THE IMPORTATION OF DISEASED LIVE STOCK (23 Stat. 31; 26 Stat. 414; 32 Stat. 791; 33 Stat. 1264).

Three cases involving apparent violations of the act of May 29, 1884 (23 Stat. 31), were reported to the Attorney General. At the close of the fiscal year 1916, 1 case was pending. One case reported during 1917 was terminated favorably to the Government, a fine of \$100 being imposed. At the close of 1917, 3 cases were pending.

No cases were reported to the Attorney General under the act of August 30, 1890 (26 Stat. 414). At the close of the fiscal year 1916, 2 cases were pending. Of these, 1 was dismissed and 1 was pending at the close of 1917.

Forty-one cases were reported to the Attorney General under the act of February 2, 1903 (32 Stat. 791). At the close of 1916, 6 cases were pending and sentence stood suspended in 1. Twenty-

six cases reported during 1917 and 5 pending at the close of 1916, in all 31 were terminated. Twenty-eight resulted in convictions upon which fines aggregating \$3,175 were imposed; 2 were dismissed and 1 was determined adversely to the Government; at the close of 1917, 16 cases were pending and sentence stood suspended in 1.

One hundred and sixty-seven apparent violations of the act of March 3, 1905 (33 Stat. 1264), were reported to the Attorney General. At the close of the fiscal year 1916, 38 cases were pending. One in which the grand jury had refused to indict, and which had consequently been reported closed in 1915, was again presented to the grand jury during the fiscal year 1917, and a true bill was found. Seventeen cases pending at the end of the fiscal year 1916, the case which was reopened during 1917, and 18 cases reported during 1917, in all 36 cases were terminated. Twenty-eight cases were terminated by convictions. In 2 the defendants could not be located and the cases were dropped; in 2 the defendants were discharged by the United States commissioner; 1 was dismissed at cost of defendant; and 3 were dismissed. In 1 case against 2 defendants a fine of \$100 was imposed against one and the case is pending as to the other. Fines aggregating \$3,110 were imposed in 29 cases. At the close of 1917, 170 cases were pending.

In each of the 208 cases reported to the Attorney General under the acts of February 2, 1903, and March 3, 1905, a suggested form of criminal information was prepared and submitted therewith for use by the United States attorney in instituting the prosecution.

The fines imposed in cases under the animal quarantine laws were:

Number of cases.	Amount of fines.	Total.	Number of cases.	Amount of fines.	Total.
1	\$10	\$10	3	\$200	\$600
51	100	5,100	1	400	400
1	125	125			
1	150	150	58		6,385

Several amendments of Bureau of Animal Industry Order 209, governing the inspection and quarantine of live stock imported into the United States under the act of August 30, 1890, were prepared, and a large number of permits for the importation of animals and correspondence in connection therewith have been considered and passed on by this office.

Under the act of February 2, 1903, regulations issued jointly by this department and the Treasury Department governing the certification and disinfection of hides and other animal by-products, hay, straw, forage, or similar material offered for entry into the United States, were prepared by this office in collaboration with the officials of the Bureau of Animal Industry. Several amendments of these regulations have since been prepared by this office. A large correspondence in connection with these regulations has received consideration by this office, and numerous conferences in reference thereto have been had with bureau officials.

Several orders of the Secretary of Agriculture establishing, modifying, and removing quarantines under section 1 of the act of 1905

were examined as to their legal form and sufficiency. A number of new regulations were likewise examined.

THE VIRUS ACT (37 Stat. 832).

No violations of the act of March 4, 1913 (37 Stat. 832), governing the preparation, shipment, and importation of viruses, serums, toxins, and analogous products intended for use in the treatment of domestic animals, were reported to the Attorney General, and no case was pending at the close of 1916.

In several cases involving the suspension or revocation of licenses issued by the Secretary to manufacturers of these products the testimony given at the hearings was reviewed by this office and the Secretary advised as to its legal effect.

THE INSECTICIDE ACT (36 Stat. 331).

Eighty-nine cases were reported to the Attorney General, in 84 of which criminal proceedings and in 5 seizures were recommended. At the close of the fiscal year 1916, 58 cases were pending, of which 54 were criminal prosecutions and 4 were seizures. Forty cases pending at the close of the year 1916 and 62 reported during the year 1917, in all 102, were terminated in 1917. Of the cases terminated, 96 were criminal and 6 civil. In the 96 criminal cases 2 violations were combined with others for the purpose of prosecution; fines were imposed in 75; sentence was suspended in 1; 17 were dropped or dismissed. After the combination for purpose of prosecution, in 62 pleas of guilty, 16 pleas of nolo contendere, and 1 a plea of non vult were entered.

In the criminal cases in which convictions were obtained the fines were as follows:

Number of cases.	Amount of fine.	Total.	Number of cases.	Amount of fine.	Total.
4.....	\$5	\$20	8.....	\$50	\$400
11.....	10	110	1.....	55	55
3.....	15	45	1.....	75	75
9.....	20	180	7.....	100	700
27.....	25	675	1.....	150	150
2.....	30	60			
2.....	40	80	75.....		2,550

Costs were assessed in a considerable number of cases in which convictions were obtained. Decrees of condemnation and forfeiture were entered in 3 civil cases; in 2 decrees were entered ordering goods destroyed, and 1 case was dismissed. At the close of the year 44 cases were pending, of which 41 were criminal prosecutions and 3 seizures.

During the year 78 notices of judgment were prepared.

THE LACEY ACT (35 Stat. 1137).

Forty cases were reported to the Department of Justice. At the close of the preceding fiscal year 29 cases were pending, of which 18 were closed during this fiscal year, 16 by convictions and the imposition of fines, 1 by acquittal, and 1 by dismissal.

Of the 40 cases reported during the year 14 were closed, 13 by convictions and the imposition of fines, and 1 by sentence to 30 days in jail. Thirty-seven cases were pending at the close of the year.

Fines were imposed as follows:

Number of cases.	Amount of fine.	Total.	Number of cases.	Amount of fine.	Total.
1.....	\$1	\$1	5.....	\$50	\$250
1.....	5	5	3.....	100	300
1.....	6	6	1.....	200	200
4.....	10	40	1.....	400	400
2.....	20	40	—		
8.....	25	200	29.....		1,522
2.....	40	80			

In addition to the fines and the jail sentence, defendants were compelled to pay substantial costs.

BIRD-RESERVES TRESPASS LAW (35 Stat. 1104).

One case was reported to the Department of Justice and was pending at the close of the year.

THE MIGRATORY-BIRD LAW (37 Stat. 847).

Twenty-five cases reported during a previous fiscal year were pending at the close of this fiscal year. The case of *United States v. Shauver* (214 Fed. 154), involving the constitutionality of the migratory-bird law, restored to the docket for reargument on February 28, 1916, was passed on motion of the Attorney General in October, 1916, subject to be called up for argument on agreement of counsel. The case had not been called for argument before the close of the fiscal year.

Numerous letters were written in response to requests from various sources for information as to the law and the regulations.

UNITED STATES COTTON-FUTURES ACT (39 Stat. 476).

Assistance was given the Office of Markets and Rural Organization in preparing orders and notices reestablishing the standards for 9 grades of white cotton and 11 grades of tinged and stained cotton, and in revising the forms of complaint, stipulation, findings, etc., for use in disputes referred to the Secretary under the act.

The office participated with the Office of Markets and Rural Organization in the consideration of 157 disputes under the act involving 5,914 bales of cotton, the total costs assessed being \$1,664.35.

Various opinions relating to the statute, distributed through the Office of Markets and Rural Organization, were prepared or reviewed.

The writs of error in the cases of *Hubbard et al. v. Lowe* and *Weld et al. v. Lowe*, involving the validity of the United States cotton-futures act of August 18, 1914, mentioned in the last annual report, were dismissed on October 9, 1916, upon motion of the Solicitor General by reason of the reenactment of the statute.

UNITED STATES WAREHOUSE ACT (39 Stat. 486).

The office cooperated with the Office of Markets and Rural Organization in the preparation of rules and regulations under the act.

The compilation of State warehouse laws, as published in *Mohun on Warehousemen*, was brought up to date for the future use of the office. Certain correspondence of the Office of Markets and Rural Organization relating to the act was reviewed, together with a bulletin on a system of accounts for cotton warehouses, which is so framed that it might be used by warehousemen licensed under the act.

Other work for the Office of Markets and Rural Organization included review and revision of numerous bulletins, including among others the subjects of the farm-loan act, farmers' mutual fire insurance, cooperative stores, farm mortgage loans, farm leases, the marketing of cotton in the Imperial Valley, marketing creamery butter, the commercial handling, grading, and marketing of potatoes, etc.; and the preparation of a discussion and forms of by-laws for cooperative agricultural associations.

A large number of cooperative agreements, news items, and miscellaneous letters, papers, and questions were reviewed and suggestions made with reference to them.

A conference was held in Pittsburgh with the market news service representative of the Office of Markets and Rural Organization and the United States attorney on the subject of disclosure of confidential information received by the department.

GENERAL STATUTES.

At the close of the previous year there were pending 13 cases of violations of the general criminal laws of the United States reported to the Attorney General. During the present year two such cases were reported to the Attorney General. Of the cases reported this year and coming over from previous years, 8 were disposed of. Two were abandoned for lack of sufficient evidence; in one an order of nolle prosequi was entered; in one the grand jury refused to indict because the defendant was probably insane; in one, upon a plea of guilty, the defendant was sentenced to three months' imprisonment; in one the defendant was found not guilty; in one the defendant pleaded guilty and a fine of \$1 was imposed; in one, a replevin suit for the recovery of goods of this department, the goods were recovered. At the close of the year seven cases were pending in the courts.

PATENTS.

Forty-seven applications for letters patent on inventions of employees of the department for dedication to the public were prepared and filed, an increase of 27 over the preceding year. During the year 14 were allowed and 2 disallowed.

The following table shows the status of applications on June 30, 1917:

Applicant.	Bureau.	Invention.	Disposition of application.
Orlin R. Rogers.....	Weather Bureau.....	Apparatus for recording duration of rainfall.	Allowed.
Frank F. Chase.....	Plant Industry.....	Gravity fruit separator.....	Pending.
Marion G. Donk.....	Chemistry.....	Process for producing high-grade rosin from low-grade rosin.	Allowed.
Marion Dorset and Howard J. Shore.....	Animal Industry.....	Process for the manufacture of concentrated hog-cholera antitoxin.	Pending in interference.
Herbert H. Bunzel.....	Plant Industry.....	Thermostat.....	Disallowed.
Herbert C. Gore.....	Chemistry.....	Process for preserving fruit juices.	Pending.
Harrison E. Patten.....	.....do.....	Apparatus for impregnating liquids with gas.	Allowed.
Thomas B. Lear.....	Animal Industry.....	Stamping tool or punch.....	Do.
John F. Barghausen.....	Plant Industry.....	Interlocking device.....	Pending.
Frederick C. Weber and Frank M. Allen.....	Chemistry.....	Machine for cutting and eviscerating fish.	Allowed.
Edmund B. McCormick.....	Public Roads and Rural Engineering.	Torsion dynamometer.....	Do.
George A. Olson.....	.....do.....	Process for drying gluten.	Pending.
Leonard R. Ingersoll.....	Forest Service.....	Apparatus for measuring the gloss of nonmetallic surfaces.	Allowed.
Harry D. Tiemann.....	.....do.....	Dry kilns for drying lumber and other moisture-bearing substances.	Do.
William R. Ross, Albert R. Merz, and John N. Carothers.....	Soils.....	Concentrated fertilizers.....	Do.
Charles S. Reeves, Provost Hubbard, and Richard H. Lewis.....	Public Roads and Rural Engineering.	Process for preparing waterproof paving material.	Pending.
Peter A. Yoder.....	Plant Industry.....	Sirup evaporator.....	Do.
John H. Clack.....	Forest Service.....	Pack frame.....	Do.
Ralph B. Adams.....	.....do.....	Portable telephone.....	Do.
Jason L. Merrill.....	Markets.....	Method for making flax tow.....	Allowed.
Paul J. Fox.....	Soils.....	Process for extracting potash and alumina from alunite.	Do.
John F. Barghausen.....	Plant Industry.....	Machine for gathering crimson clover.	Pending.
Otto Kress and Sidney D. Wells.....	Forest Service.....	Process of cooking wood pulp.....	Do.
William F. Oglesby.....	.....do.....	Device for clipping olives and other fruit pits.	Do.
Kan Smith.....	Forest Service.....	Compass altimeter.....	Do.
William R. Ross, Albert R. Merz, and John N. Carothers.....	Soils.....	Process for the manufacture of a concentrated fertilizer.	Do.
Harry D. Gibbs and Geo. A. Geiger.....	Chemistry.....	Process of manufacturing chlorine compounds.	Do.
Do.....	.....do.....	Apparatus for making chlorine compounds.	Disallowed.
Albert R. Merz, William R. Ross, and John N. Carothers.....	Soils.....	Method for the recovery of phosphorous fumes evolved in the volatilization method of treating phosphate rock.	Pending.
Charles F. Payne.....	Animal Industry.....	Combination marking pot and stencil-brush ink.	Allowed.
Frederick H. Colburn.....	Forest Service.....	Improvement in relief alidades.....	Pending.
William B. Osborne, jr.....	.....do.....	Device for locating the range of distant objects.	Do.
James E. Imrie.....	.....do.....	Dry kilns.....	Do.
Albert R. Merz and William R. Ross.....	Soils.....	Process for the extraction of potash and alumina from alunite.	Do.
Harry D. Gibbs.....	Chemistry.....	Oxidizing the side chains of aromatic hydrocarbons.	Do.
Robert E. Prince and Otto Kress.....	Forest Service.....	Process for fireproofing paper.....	Do.
Do.....	.....do.....	.....do.....	Do.
Marion Dorset and Richard R. Henley.....	Animal Industry.....	Process for separating serum from the corpuscles of mammalian blood.	Do.
Robert E. Prince.....	Forest Service.....	Process for fireproofing fibrous material.	Allowed.
Robert C. Palmer.....	.....do.....	Process of destructively distilling wood.	Pending.
Do.....	.....do.....	Method of destructively distilling wood.	Do.
John N. Carothers and William R. Ross.....	Soils.....	Smelting of phosphate rock.....	Do.
Logan Waller Page.....	Public Roads and Rural Engineering.	Concrete.....	Do.
Harry D. Gibbs and Courtney Conover.....	Chemistry.....	Process for the manufacture of phthalic anhydride, etc.	Do.

Applicant.	Bureau.	Invention.	Disposition of application.
Edmund B. McCormick.	Public Roads and Rural Engineering.	Recorders.....	Pending.
Clyde H. Teesdale and Robert E. Prince.	Forest Service.....	Process of fireproofing wood.....	Do.
William V. Cruess.	.....	Process for pickling olives.....	Do.
Clyde H. Teesdale.	Forest Service.....	Process of treating wood.....	Do.
Norman DeW. Betts and Harry D. Tiemann.	.....do.....	Dry kilns.....	Do.
Edward J. Hoff.....	Public Roads and Rural Engineering.	Automatic weir for regulating the flow of water.	Do.
Victor M. Cone.....	.....do.....	Venturi measuring flumes.....	Do.
J. F. Collins.....	Plant Industry.....	Method of filling cavities made by excavating the decayed or injured spots in a living tree.	Do.
Frederick W. Stanley.	Public Roads and Rural Engineering.	Automatic irrigation nozzles.....	Allowed.
Harry D. Tiemann.	Forest Service.....	Dry kilns.....	Pending.
Arlie W. Schorger.	.....do.....	Apparatus for straining crude oleoresin.	Do.
J. F. Collins.....	Plant Industry.....	Method of treating decayed spots in living trees.	Do.
Elmer Johnson and J. Clay Woodson.	Public Roads and Rural Engineering.	Fire extinguisher.....	Do.
William H. Wagman, Harry Bryan, and Cary B. Wagner.	Soils.....	Apparatus for the manufacture of phosphoric acid and compounds of the same.	Do.
Otto Kress and Howard F. Weiss.	Forest Service.....	Process for producing paper pulpboard containing bark.	Do.
Harry D. Gibbs and George A. Geiger.	Chemistry.....	Process for manufacturing side chain chlorine derivatives of toluol.	Do.
Clyde H. Teesdale.	Forest Service.....	Process for rendering lumber resistant to sap stain.	Do.
Martin N. Straughn.	Chemistry.....	Process for the preservation of fruit juices.	Do.
Satoaki Ozaki.....	.....	Process for preparing a rice food product.	Do.
Albert R. Merz and William R. Ross.	Soils.....	Process for the simultaneous production of volatile acids and phosphate salts.	Do.
James E. Imrie.....	Forest Service.....	Improvement in shrinkage take-up frames for edge stacking lumber.	Do.
Harry D. Gibbs and Courtney Conover.	Chemistry.....	Process for the manufacture of phthalic anhydride, etc.	Do.
Do.....	.....do.....	Process for the manufacture of anthraquinone.	Do.
Do.....	.....do.....	.....do.....	Do.
William G. Taggart.....	.....do.....	Method of manufacturing decolorizing carbon.	Do.

AGREEMENTS FOR THE SEVERAL BUREAUS, DIVISIONS, AND OFFICES.

The following table shows the number of contracts and leases prepared or examined for sufficiency and proper execution for the various bureaus, divisions, and offices of the department:

Bureau, division, or office.	Contracts.	Leases.	Bureau, division, or office.	Contracts.	Leases.
Bureau of Animal Industry.....	20	44	Office of Markets.....	6	61
Biological Survey.....	2	1	Bureau of Plant Industry.....	70	47
Bureau of Chemistry.....	8	1	Office of Public Roads.....	12	3
Chief clerk.....	6	20	Bureau of Soils.....	12	1
Bureau of Crop Estimates.....	1	6	Supply Division.....	4	.....
Bureau of Entomology.....	7	35	Weather Bureau.....	42	29
Federal Horticultural Board.....	.....	1	Solicitor's Office.....	.....	1
Forest Service.....	1,720	7			
Insecticide and Fungicide Board.....	2	.....	Total.....	1,914	262
Library.....	2	.....		

There were also prepared 25 bonds, 185 renewals, and 11 notices of terminations of contracts.

PUBLICATIONS OF THE OFFICE.

Under authority of section 4 of the food and drugs act, and section 4 of the insecticide act, there were issued 578 notices of judgment.

The article prepared by the Solicitor during a previous fiscal year and published in the February and March, 1916, issues of "Case and Comment," containing a brief statutory history of the Department of Agriculture, with a discussion of the constitutionality of the organic act creating the department and of the various acts of Congress upon which the activities of the department are based, was published during the year as a circular of the Department of Agriculture.

A fourth supplement to the "Laws Applicable to the United States Department of Agriculture" was prepared.

One circular was issued containing the decision of the Circuit Court of Appeals for the sixth circuit, in the case of *Simpson v. United States* (Circular No. 88).

REPORT OF THE INSECTICIDE AND FUNGICIDE BOARD.

UNITED STATES DEPARTMENT OF AGRICULTURE,
INSECTICIDE AND FUNGICIDE BOARD,
Washington, D. C., September 27, 1917.

SIR: I have the honor to submit herewith a concise report on the work of the Insecticide and Fungicide Board for the fiscal year ended June 30, 1917.

Respectfully,

J. K. HAYWOOD,
Chairman of Board.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The insecticide act of 1910 empowers the department to proceed criminally against shippers of adulterated or misbranded insecticides or fungicides, or seize shipments of adulterated or misbranded insecticides or fungicides, provided that the goods enter interstate commerce, or are offered for import or export, or are manufactured, sold, or offered for sale in the District of Columbia or the Territories. A survey of the work of enforcing the insecticide act of 1910 during the year reveals that there has been an increase over the preceding year in the amount of work required to be done. This is due to a great extent to the apparent effort of manufacturers to use new ingredients in their products which has necessitated an increasing amount of work in the adaptation of methods of analysis and test to special cases in which these new combinations, and sometimes new and unusual substances, occur.

INTERSTATE SAMPLES.

During the fiscal year the board reported to the solicitor of the department 126 cases presenting alleged violations of law and with recommendations that the facts be transmitted to the Attorney General to institute criminal action or seizure proceedings. Disposition was made of 240 cases by correspondence with the manufacturers. These cases presented violations which were technical only, were not flagrant, or cases in which the manufacturer gave reasonable and adequate explanation of his failure to conform to the provisions of the act. Action was taken to place in abeyance 795 samples, which, upon examination and test, were shown to be in compliance with the provisions of the law or were from shipments of the same goods made prior to shipments for which the manufacturer had been convicted and had after citation conformed to the requirements of the law. On June 30, 1917, 94 cases were pending preliminary hearings or before the board for final action, 280 were held in temporary abeyance pending the receipt of further information or the outcome of prosecutions based on the same product, or corre-

spondence with the manufacturers, and 274 samples were undergoing analysis and test.

The inspectors and sample collectors of the board, operating throughout the United States, collected 984 samples during the year. A general classification of the articles represented in the collection is as follows:

Samples collected.	No. of samples.	Samples collected.	No. of samples.
Arsenate of lead.....	76	Insect preparations, household use.....	156
Arsenate of zinc.....	2	Insecticide and fungicide preparations, agricultural use.....	85
Bordeaux mixture and combinations of Bordeaux mixture with insecticides.....	63	Kerosene emulsions.....	9
Chlorinated lime.....	18	Lice and mite killers.....	83
Cyanides and cyanide mixtures.....	4	Lime-sulphur solution and sulphur preparations.....	51
Dips for animals.....	44	Nicotine preparations.....	23
Disinfectants, germicides, bactericides.....	148	Paris green.....	22
Fly preparations, for animals.....	36	Pyrethrum and hellebore powders.....	51
Fish-oil and whale-oil preparations.....	17	Miscellaneous.....	84
Formaldehyde preparations.....	12		

IMPORT SAMPLES.

During the year 35 official and unofficial import samples of insecticides and fungicides were collected by the various port laboratories of the Bureau of Chemistry for examination and test by the board. Disposition was made of 30 samples, no official samples being found not adulterated or misbranded, and 12 adulterated or misbranded, or both, and it was recommended that entry to this country be entirely forbidden or that the consignments be released when correctly labeled. The remaining samples were unofficial, 7 of them being found to be adulterated or misbranded, or both, and in these cases it was recommended that future shipments be detained, while 11 were neither adulterated nor misbranded.

The preceding annual report of the board contained a statement showing the progress made each year since the enactment of the law in reducing violations thereof in relation to certain commonly used spraying materials. The statement given below has been augmented to include the year 1916. The increase in violations in respect to lead arsenates and lime-sulphur solutions is due primarily to the fact that the efforts of the inspection force were directed to the products of manufacturers and repackers who were marketing products of doubtful composition or were suspected of making incorrect claims for efficacy in their labels.

Percentage of violations.

Shipped interstate, year.	Lead arsenate.	Paris green.	Lime-sulphur solution.	Bordeaux mixture and Bordeaux mixture combined with insecticides.
	Per cent.	Per cent.	Per cent.	Per cent.
1911-12.....	60	28	94	98
1913.....	30	21	86	71
1914.....	20	19	27	49
1915.....	8	19	14	36
1916.....	32	8	25	32

SPECIAL INVESTIGATIONS.

During the past year and for a year or two previous to this the chemists of the board have made investigations to determine how lead arsenates sold in interstate commerce should be labeled and to obtain scientific information relative to the preparation and properties of the various lead arsenates. Work on this subject completed during the fiscal year ending June 30, 1916, was published in the form of two papers during the fiscal year ending June 30, 1917, viz, "The Preparation and Properties of Lead Chlor Arsenate—Artificial Mimetite," *The American Journal of Science* (ser. 4), volume 42, page 139, August, 1916, and "The Arsenates of Lead. First Paper," *Journal of the American Chemical Society*, volume 38, page 2027, October, 1916.

During the fiscal year ending June 30, 1917, work was completed on two more papers on this subject, the titles and references to which follow: "The Arsenates of Lead. Second Paper," *Journal of the American Chemical Society*, volume 38, page 2366, November, 1916, and "The Arsenates of Lead. Third Paper, Basic Arsenates," *Journal of the American Chemical Society*, volume 39, No. 5, page 937, May, 1917.

Work also was completed on a study of the action of water on dilead arsenate, and the paper was prepared and accepted for publication in the *Journal of the American Chemical Society* under the title of "The Action of Water on Dilead Arsenate."

The investigation started some time ago to discover a chemical method of determining stems in insect powder, establish standards for insect powder, and study the process of manufacture of insect powder and composition of raw materials as well as the finished product, prepared under known conditions, has been completed and will shortly be offered for publication as a bulletin under the title "Insect Powder."

A paper has been prepared and accepted for publication in the *Journal of Agricultural Research* under the designation, "The Occurrence of Manganese in *Chrysanthemum Cinerariaefolium*."

An investigation of the various calcium arsenates has been in progress for nearly two years and several new calcium arsenates have been prepared and the properties of same studied. Information, both of practical and scientific importance, has been obtained which will later be collated and offered for publication.

Work has been started for the purpose of determining the composition and methods of preparation of tobacco dust sold on the American market and establishing satisfactory standards for this product. All of the larger firms producing this product have been interviewed and many samples have been collected for chemical investigation and study. The results of this work will be of great service in recognizing adulteration and misbranding of this class of goods.

Aside from the routine work of testing the efficacy of proprietary insecticides and fungicides, the entomologists and plant pathologists of the board have continued the investigations relative to the practical value of a number of substances in the control of certain insects and diseases, including pyrethrum powders, tobacco powders, and nico-

tine solutions against different classes of insects; field and laboratory studies of the action of various chemicals on scale insects; special investigations of the value of stems of pyrethrum against different classes of insects were made; exhaustive tests and studies were made of the action of a large number of chemicals on roaches, bedbugs, clothes moths, chicken lice, dog fleas, aphids and red spiders, the results of which will be published. In cooperation with the Bureaus of Entomology and Plant Industry the field tests of the value of dust mixtures were continued and information of much value in connection with the enforcement of the act was obtained. The scope of the work has been materially increased this year in order to cover a larger list of fruits and vegetables. In these tests special reference has been made to finely ground sulphur and powdered lead arsenate diluted with varying proportions of lime and gypsum. These tests have also included considerable work with dry Bordeaux dusts as compared to the liquid homemade mixture.

Data of value in the enforcement of the insecticide act have been obtained through investigations made in cooperation with the scientists of the Bureau of Animal Industry, of certain products known as "Salt-Blocks," which were falsely labeled as tick eradicators, of products sold for use against bots infesting horses, and relative to the use of soda lye as a remedy for and preventive against worms infesting hogs.

"A Simple Improved Apparatus for Hydrogen Sulfide Precipitation" has been devised and described in *The Journal of Industrial and Engineering Chemistry*, volume 9, page 572, August, 1917.

REPORT OF THE FEDERAL HORTICULTURAL BOARD.

UNITED STATES DEPARTMENT OF AGRICULTURE,
FEDERAL HORTICULTURAL BOARD,
Washington, D. C., September 29, 1917.

SIR: I submit herewith an executive report covering the administration of the plant quarantine act for the fiscal year ending June 30, 1917.

Respectfully,

C. L. MARLATT,
Chairman of Board.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

FEDERAL PLANT QUARANTINE ACT.

Under the Federal plant quarantine act of August 20, 1912, as amended March 4, 1913, and March 4, 1917, the entry of foreign nursery stock and other plants and plant products into the United States is regulated, and domestic and foreign quarantines on account of plant diseases and insect pests are established and maintained.

The amendment of this act, approved March 4, 1917, has relation to section 8, the domestic quarantine section. As hitherto worded, this section restricted the promulgation of quarantines to any State, Territory, or District of the United States, or any portion thereof, which could be definitely determined by the Secretary of Agriculture as being invaded by the plant disease or insect involved. The new wording authorizes the Secretary of Agriculture to promulgate a quarantine to include "any State, Territory, or District of the United States, or any portion thereof, when he shall determine that such quarantine is necessary to prevent the spread of a dangerous plant disease or insect infestation"; in other words, without the requirement of the determination of the actual infestation of such area as a whole. Such broad power need be exercised only in the case of diseases or infestations like that of the white-pine blister rust or the citrus canker, where the actual spread can not be accurately determined. A further modification of this section authorizes the Secretary of Agriculture to quarantine and regulate the movement, in addition to plants and plant products, of "any class of stone or quarry products or any other article of any character whatsoever

capable of carrying any dangerous plant disease or insect infestation specified in the notice of quarantine."

ADMINISTRATION AND PERSONNEL.

The Federal Horticultural Board provided for in the act for its administration remains the same as last year, namely: C. L. Marlatt, chairman, Bureau of Entomology; W. A. Orton, vice chairman, Bureau of Plant Industry; George B. Sudworth, Forest Service; W. D. Hunter, Bureau of Entomology; Karl F. Kellerman, Bureau of Plant Industry. The principal administrative officers of the board are R. C. Althouse, secretary of the board and in charge of the administrative office; L. E. Palmer, in charge of cotton importations; E. R. Sasscer, chief inspector; and R. Kent Beattie, chief pathological inspector.

The board maintains at important ports of entry, namely, New York, Boston, Seattle, San Francisco, Calexico and other Mexican border ports, an inspection service to enforce the inspection and other requirements of entry of plants and plant products admitted into the United States under regulation (see list of quarantine and regulatory orders at the end of this report). The inspection force at New York consists of Mr. H. B. Shaw, chief, with three assistants; at Boston, of Mr. R. I. Smith, with two assistants; at Seattle, of Mr. A. G. Webb; at San Francisco, of Mr. Frederick Maskew, with a considerable number of assistants, all State men, acting as collaborators of the board; at Calexico, of Mr. O. A. Pratt; and the Texas-Mexico control and border service of Mr. T. C. Barber, with seven assistants distributed between the ports of El Paso, Eagle Pass, Laredo and Brownsville. This Texas-Mexico border service has particular relation to the prevention of the entry of the pink bollworm discussed elsewhere in this report.

The board maintains effective cooperation with the inspection service of the several States, more particularly in carrying out the regulations governing entry of foreign nursery stock. The number of State inspectors acting as collaborators of the board remains substantially the same as last year, namely, 68.

The State, Treasury, and Post Office Departments have, as in former years, rendered efficient aid in the enforcement of the various quarantine and restrictive orders promulgated under the plant quarantine act.

TERMINAL INSPECTION OF INTERSTATE MAIL SHIPMENTS OF PLANTS AND PLANT PRODUCTS.

During the year the State of Florida availed itself of the provisions of the act of March 4, 1915, by providing for terminal inspection of mail shipments of plants and plant products originating in other States. California was the first State to make provision for such inspection in 1915 and was followed in 1916 by Arizona and Montana. All plants and plant products shipped to these four States under the certification of the Federal Horticultural Board are exempted from such inspection.

NEW PLANT QUARANTINES.

The domestic and foreign quarantines described below are additional or supplementary to the quarantines previously established:

FOREIGN QUARANTINES.

WHITE-PINE BLISTER RUST QUARANTINE.—Amendment No. 2 to Notice of Quarantine No. 7, promulgated April 21, 1917, forbids the importation into the United States from each and every country of Europe and Asia of all species and varieties of currant and gooseberry plants (*Ribes* and *Grossularia*), known to be intermediate host plants, to prevent the further introduction into the United States of the white-pine blister rust.

COTTON SEED QUARANTINE.—Amendment No. 3 to Notice of Quarantine No. 8, promulgated November 4, 1916, revokes amendments 1 and 2 to Notice of Quarantine No. 8, which amendments permitted the importation of cotton seed (including seed cotton) and cottonseed hulls from the States of Nuevo Leon, Tamaulipas, Coahuila, Durango, and Chihuahua, Mexico, for manufacturing purposes. This action was taken on account of the discovery of the occurrence of the pink bollworm in the Laguna district of Mexico.

Amendment No. 4 to Notice of Quarantine No. 8, promulgated March 7, 1917, effective on and after July 1, 1917, makes provision for the importation of cotton seed, seed cotton, and cottonseed hulls from the locality of the Imperial Valley in the State of Lower California, Mexico, under permit from the Secretary of Agriculture and inspection at the port of entry. As a further condition of such entry effective quarantine measures must be maintained by Mexico preventing the entry into Lower California of cotton seed, seed cotton, cottonseed hulls, and lint cotton, baled or unbaled, grown in other parts of Mexico or in foreign countries other than the United States.

INDIAN CORN QUARANTINE.—Amendment No. 1 to Notice of Quarantine No. 24, promulgated March 1, 1917, effective on and after April 1, 1917, makes provision for the importation of Indian corn or maize from Japan and Manchuria under permit and in accordance with the other requirements of the regulations, including sterilization of the corn at the port of entry as a condition of entry.

Amendment No. 2 to Notice of Quarantine No. 24, promulgated April 23, 1917, provides for the importation of Indian corn or maize from the other countries covered by Notice of Quarantine No. 24, namely, southeastern Asia (including India, Siam, Indo-China, and China), Malayan Archipelago, Australia, New Zealand, Oceania, Philippine Islands, and Formosa, under the same regulations.

CITRUS FRUIT QUARANTINE.—Notice of Quarantine No. 28, promulgated June 27, 1917, effective on and after August 1, 1917, prohibits the importation into the United States from eastern and southeastern Asia (including India, Siam, Indo-China, and China), the Malayan Archipelago, the Philippine Islands, Oceania (except Australia, Tasmania, and New Zealand), Japan (including Formosa and other islands adjacent to Japan), and the Union of South Africa of all species and varieties of citrus fruits, excepting only oranges

of the mandarin class (including satsuma and tangerine varieties) on account of a dangerous disease known as citrus canker. Oranges of the mandarin class may be entered under permit, foreign certification, and reinspection on arrival by an inspector of the Department of Agriculture.

DOMESTIC QUARANTINES.

MEDITERRANEAN FRUIT FLY AND MELON FLY QUARANTINE.—Quarantine No. 13, revised, promulgated March 12, 1917, effective on and after June 1, 1917, amends and supersedes Quarantine No. 13, promulgated March 23, 1914. This quarantine prohibits the movement from the Territory of Hawaii into or through any State, Territory, or District of the United States, other than Hawaii, of all fruits and vegetables in the natural or raw state except in manner or method or under conditions prescribed in the regulations of the Secretary of Agriculture. Under the quarantine provision has been made in the regulations for the shipment to the mainland of bananas, pineapples, taro, and coconuts. Other fruits and vegetables may be added to this list when it can be shown that such fruits and vegetables in the form in which they are to be shipped are not and can not be a means of conveying either the Mediterranean fruit fly or the melon fly.

WHITE-PINE BLISTER RUST QUARANTINE.—Quarantine No. 26, promulgated April 21, 1917, effective on and after June 1, 1917, quarantines all the States east of and including the States of Minnesota, Iowa, Missouri, Arkansas, and Louisiana, and prohibits the interstate movement to points outside the quarantined area of all five-leaved pines and currant and gooseberry plants on account of the white-pine blister rust. The quarantine order provides further that no five-leaved pines or black currant plants shall be moved or allowed to move interstate to points outside the area comprising the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, and New York. The States just named are the ones most seriously infected.

Immediately following the promulgation of this quarantine it was brought to the attention of this board by the State officials of New York and Pennsylvania that considerable shipments of white pine were being made into these States from New England points in violation of State quarantines. In order to stop further shipments of this kind and at the request of the State officials referred to, Quarantine No. 26 was amended May 1, 1917, by ordering that from and after that date no five-leaved pines or black currant plants should be moved or allowed to move interstate to points outside the area comprising the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

The survey conducted by the Bureau of Plant Industry, in cooperation with this board, referred to in last year's report, indicates that the white-pine blister rust has continued its spread in this country and that it now occurs in several additional States heretofore believed to be free from it.

GIPSY MOTH AND BROWN-TAIL MOTH QUARANTINE.—Quarantine No. 27, promulgated June 8, 1917, effective on and after July 1, 1917, was originally issued November 5, 1912, as Quarantine No. 4, and has been revised and amended annually to embody the annual revision of

the territory necessitated on account of the changes in distribution of these two insects. This quarantine defines the district in New England infested by the gipsy moth and the brown-tail moth and prohibits the movement in interstate commerce of plants and plant products and stone or quarry products except in accordance with the regulations prescribed therein. The spread of the brown-tail moth during the year was so slight that it was not necessary to extend the quarantine line on account of this pest. The spread of the gipsy moth was also very limited.

As in previous years, the cost of administering this quarantine was paid out of the special appropriation for preventing spread of moths granted to the Bureau of Entomology.

THE PINK BOLLWORM.

The appearance this year of the pink bollworm enemy of cotton in two important cotton-producing countries of this hemisphere, namely, Brazil and Mexico, has added a new and very serious element of menace to the cotton crop of our Southern States.

THE PINK BOLLWORM IN BRAZIL.

The entry and wide distribution of this insect in Brazil, we are advised, came from the introduction by the Brazilian Government between the years 1911-1913 of some 900 tons of Egyptian cotton seed, which was distributed for planting through the various cotton-growing States of Brazil. The existence of the pink bollworm, a new enemy of cotton in Egypt, was not known to Brazilian authorities and this seed was not submitted to any special inspection or to any means of disinfection, with the result that the pink bollworm has been generally distributed and apparently thoroughly established in Brazil.

THE PINK BOLLWORM IN MEXICO.

In Mexico the introduction of this pest as now known came about in a similar manner, namely, through the importation by individuals of a considerable quantity of Egyptian seed in 1911. This seed was first planted in the vicinity of Monterey, Mexico, and the seed product of this crop, undoubtedly more or less infested with the pink bollworm, was taken for planting into the very important Laguna cotton district in north central Mexico.

The existence of this pest in Mexico was determined by this department on November 1, 1916, as a result of the receipt of specimens of infested bolls from a planter in the Laguna district. These bolls were supposed by this planter to be infested with the common Mexican boll weevil, but proved on examination by specialists of the department to contain, in addition to the boll weevil, examples of the pink bollworm of India and Egypt. This unexpected determination of the occurrence of the pink bollworm in Mexico was followed by the issuance of an order by this department (Nov. 4, 1916), prohibiting the further entry into the United States from Mexico, with the exception of the Imperial Valley, State of Lower California, of all cotton seed, cottonseed hulls, and seed cotton, and bringing under regulation and restriction as to ports of entry Mexican cotton lint of all kinds.

The exception of the Mexican portion of the Imperial Valley is warranted, in the belief of the experts of the department, by the fact that no foreign seed has been brought to this valley and that cotton culture in this valley in Mexico is continuous with that on the American side of the line. This district is furthermore separated by the Gulf of Lower California and hundreds of miles of arid plains and mountains from the infested region of northeastern Mexico, and is further protected by strict quarantine and inspection measures enforced by the Government of Mexico in cooperation with the inspection service of this department. Entry of the products from the Mexican portion of this valley is further restricted and protected by regulations.

The original quarantine of July 1, 1913, on account of the pink bollworm, prohibiting the importation of cotton seed and hulls from all foreign countries except from the Imperial Valley of Lower California, was, in 1913-14, lifted as to certain other northern Mexican States, permitting seed and hulls from these States to enter the United States under permit and regulation for milling purposes only. This action was based on the fact that the principal Mexican cotton-growing districts had been repeatedly inspected by experts of this department, and no infesting insects had been found in Mexico not already widespread in the United States, and was taken at the earnest solicitation of certain cotton mills in Texas which had hitherto been the principal purchasers of such Mexican seed and would be seriously affected by the cutting off of this source of supply. This department at that time had no knowledge of any importation of Egyptian or other foreign seed into Mexico.

Following the establishment of a strict quarantine against such products from Mexico on November 4, accurate information was obtained of the disposition of the cotton seed which had come across the border under permit during the season 1916. Prior to that year practically no Mexican cotton seed had been shipped to the United States from Mexico and it was only the disturbed conditions in Mexico and the high prices in the United States which caused the large movement of Mexican seed from the Laguna to the United States in 1916. A total of 436 cars of Mexican seed had entered the United States during this year prior to November 4. This seed went to mills at the following points: Dallas, San Antonio, Hearne, Houston, Beaumont, New Braunfels, Alice, Pearsall, Kaufman, Grand View, and Wolfe City.

CONTROL WORK IN TEXAS.

The Federal Horticultural Board, in cooperation with the State authorities of Texas, began an immediate campaign to expedite the milling of this seed and the destruction of any scattered seed about the premises. This work was carried out with great thoroughness under the direction of experts of the board, Bureau of Entomology, and the Office of Markets and Rural Organization of this department and with the heartiest cooperation on the part of the mills concerned and of the Cottonseed Crushers' Association of Texas.

To meet the situation described in Texas and Mexico, an estimate for an emergency appropriation of \$50,000 was submitted to Congress. This appropriation did not, however, become available until March 4, 1917. In the meantime the control work referred to was

immediately instituted with the aid of funds available from the regular appropriation for the Federal Horticultural Board. The scope of this work is indicated in the wording of the special appropriation referred to, as follows:

To enable the Secretary of Agriculture to meet the emergency caused by the existence of the pink bollworm of cotton in Mexico and the movement of some five hundred carloads of cottonseed from the infested districts in Mexico to milling points in Texas and elsewhere, and to prevent the establishment of such insect in Texas or in any other State by providing for adequate inspection and the employment of all means necessary under rules and regulations to be prescribed by him, to prohibit the movement of cotton and cottonseed from Mexico into the United States, including the examination of baggage and railroad cars or other means of conveyance and the cleaning and disinfection thereof; to inspect mills in Texas or elsewhere in the United States to which Mexican cotton seed has been taken for milling; to supervise the destruction, by manufacture or otherwise, of such seed and the thorough clean-up of the mills and premises; to conduct local surveys and inspections of cotton fields in the vicinity of such mills and ports of entry in order to detect any instances of local infestation; and to determine and conduct such control measures in cooperation with the State of Texas or other States concerned as may be necessary to stamp out such infestation, including rent outside of the District of Columbia, employment of labor in the city of Washington and elsewhere, and all other necessary expenses, \$50,000, available immediately and until expended.

The inspection force to take up the work as indicated in the wording of the appropriation, namely, (1) the clean-up of the mills which had received cotton seed and the inspection and safeguarding of adjacent cotton fields, and (2) the border control, including control of all car and freight traffic between Mexico and the United States, was put under the field charge of Mr. T. C. Barber, with headquarters at San Antonio. A number of entomologists were assigned to the work of mill and field inspection during the summer, and inspectors were assigned to take charge of the border-control work, ultimately distributed as follows: one at Brownsville, two at Laredo, two at Eagle Pass, and two at El Paso. The small and occasional importations through subsidiary ports on the Mexican border are being handled by the inspectors at the main ports.

The clean-up of the mills was made as promptly and as thoroughly as the conditions would permit, but in some instances the Mexican seed was overlaid with vast quantities of domestic seed, and this delayed in some instances until fairly late in the spring the completion of the milling of the entire mass and the final clean-up of the premises.

During the growing season of 1917 inspectors made frequent examinations of all cotton fields in the vicinity of the mills which had received Mexican cotton seed to determine at the earliest moment whether any of the insects had escaped from the imported seed and infested the adjacent fields, provision being made for the prompt destruction of cotton in any field showing any sign of infestation. No trace of infestation in Texas by the pink bollworm was found during the summer, and the outlook was promising that the insect had failed to establish itself.¹

¹ Subsequent to the period covered by this report three outbreaks of the pink bollworm have been determined in Texas. Two of these have been in connection with mills which had received seed from Mexico during 1916, namely at Hearne, reported September 12, and at Beaumont, reported October 15. The infestation at these two points was sporadic and very slight, and clean-up operations of the most thoroughgoing character have presumably stamped out these infestations. The third point is at Anahuac, Tex., reported October 31, and involves many cotton fields, representing, however, a total of only some 50 acres. No explanation of this infestation is now available. Clean-up operations are being instituted. [C. L. M., Nov. 8, 1917.]

Drastic rules and regulations have been issued governing the importation of cottonseed cake, meal, and other cottonseed products into the United States from Mexico and other foreign countries, and the regulations governing the importation of cotton lint have been readjusted to meet these new emergencies. Regulations have also been issued and are being enforced governing the railway and other traffic between Mexico and the United States to safeguard against the accidental entrance of infested seed or insects in connection with such general traffic.

EXPLORATION IN MEXICO.

To secure as definite information as was possible of the distribution of the pink bollworm in the Laguna district and perhaps elsewhere in Mexico, Mr. August Busck, an expert of the Bureau of Entomology, was commissioned by the Federal Horticultural Board to conduct as thoroughgoing an investigation as was possible under the disturbed conditions then obtaining in Mexico. It was desired particularly to determine the possibility of extermination of the pest in Mexico in cooperation with the Mexican Government, and the expedition which was to have been a cooperative one between the United States and Mexico was undertaken after a long series of communications with the Mexican authorities and the Mexican ambassador designate in Washington, conducted through the agency of the Department of State. Unfortunately the conditions were such in Mexico early in April when the investigation was undertaken, that it could only be imperfectly completed. Information as to and samples of seed from, the principal ranches in the Laguna were obtained, which indicated the general distribution of this pest throughout the Laguna district, and exact information was obtained of the importations of seed in 1911 from Egypt which brought this pest into Mexico.

Mr. Busck made a minute inspection of the cotton plantings in Mexico near the American border from Matamoros to Eagle Pass and was unable to find any evidence of infestation of cotton fields in this region up to the season of 1917. Two instances of fields planted with seed from the Laguna, however, were located—both of these near the American border. These fields will be kept under observation by agents of the board and further explorations in Mexico will be undertaken as conditions permit.

TECHNICAL INFORMATION FOR INSPECTORS.

In continuation of work conducted by Mr. Busck in Hawaii in relation to this insect, recorded in last year's report of this board, a technical paper on the pink bollworm prepared by Mr. Busck has been published, in which are given descriptions and technical drawings which will enable any competent entomologist to identify this insect in any of its stages. This paper will be of great value to inspectors and others connected with the work of enforcement of the cotton quarantine and regulations.

NURSERY STOCK IMPORTATIONS.

FOREIGN COUNTRIES MAINTAINING INSPECTION SERVICE.

The following countries have provided for inspection and certification of nursery stock in conformity with the regulations prescribed under the plant quarantine act:

Australia.	Ireland.	Philippine Islands.
Barbados.	Italy—Province of Pa-	Scotland.
Belgium.	dova (Padua) only.	Union of South Africa.
Bermuda.	Jamaica.	Spain.
British Guiana.	Japan.	Straits Settlements.
Canada.	Leeward Islands:	Switzerland.
Cuba.	Antigua.	Trinidad.
Denmark.	St. Christopher-Nevis.	Wales.
England.	Dominica.	Windward Islands:
France.	Montserrat.	Granada.
Germany.	Virgin Islands.	St. Lucia.
Guatemala.	Luxemburg, Grand	St. Vincent.
Holland.	Duchy of.	
Hongkong.	New Zealand.	

This list includes practically all of the countries which have hitherto maintained any considerable commercial trade in nursery stock with the United States. Any other country may obtain the privilege of commercial exportation to the United States by providing an inspection service.

DISTRIBUTION OF IMPORTED NURSERY STOCK, BY STATES.

The following table indicates the distribution by States of nursery stock imported during the fiscal years 1913-14, 1914-15, 1915-16, and 1916-17:

Distribution of imported nursery stock, by States.

State.	Number of cases.			
	1916-17	1915-16	1914-15	1913-14
Alabama.....	173	284	241	125
Arizona.....				4
Arkansas.....	26	22	95	11
California.....	4,891	2,403	3,357	1,929
Colorado.....	162	152	150	152
Connecticut.....	801	1,972	1,372	1,432
Delaware.....	54	53	40	38
District of Columbia ¹	422	491	549	562
Florida.....	200	1,466	2,461	56
Georgia.....	223	191	228	196
Hawaii.....	79	57	20	4
Idaho.....	6	4	5	9
Illinois.....	2,891	4,671	3,316	3,942
Indiana.....	464	577	569	545
Iowa.....	731	905	1,066	394
Kansas (north).....	105	55	51	48
Kansas (south).....	96	292	292	286
Kentucky.....	188	410	320	352
Louisiana.....	228	279	400	416
Maine.....	53	66	42	51
Maryland.....	308	595	756	553
Massachusetts.....	2,112	4,769	4,221	5,115
Michigan.....	910	1,325	1,562	1,232
Minnesota.....	300	746	701	528
Mississippi.....	40	21	23	35
Missouri.....	380	513	592	676
Montana.....	36	32	20	26
Nebraska.....	151	249	217	149

¹ In addition to the commercial shipments referred to, during the period 1916-17 some 3,530 departmental importations for scientific purposes have been inspected by inspectors of the Federal Horticultural Board.

Distribution of imported nursery stock, by States—Continued.

State.	Number of cases.			
	1916-17	1915-16	1914-15	1913-14
Nevada.....			1	2
New Hampshire.....	40	44	53	57
New Jersey.....	6,860	13,295	8,829	10,458
New Mexico.....				1
New York.....	8,058	16,325	12,669	12,363
North Carolina.....	70	121	80	162
North Dakota.....	20	66	12	8
Ohio.....	2,447	3,314	3,374	3,068
Oklahoma.....	14	17	15	13
Oregon.....	328	355	480	560
Pennsylvania.....	3,638	6,096	6,556	9,309
Rhode Island.....	212	563	741	606
South Carolina.....	25	41	39	41
South Dakota.....	19	29	16	16
Tennessee.....	161	185	197	200
Texas.....	183	151	139	184
Utah.....	19	25	27	35
Vermont.....	17	41	24	20
Virginia.....	273	379	354	338
Washington.....	388	421	403	482
West Virginia.....	129	87	87	102
Wisconsin.....	429	509	430	334
Total.....	39,358	64,652	57,192	57,525

The total importations of nursery stock from foreign countries indicated in this statement for the last four years is interesting in view of war conditions affecting the principal exporting countries, namely, France, Holland, and Belgium. The importations of 1913-14 were not influenced by the war, as these importations were completed before the war began. The war had no effect on importations during the next two years and, in fact, there was an increase during the second year of the war, 1915-16. A marked decrease is shown, however, in the last year, 1916-17. The succeeding table shows the country of origin, amount, and nature of these nursery stock importations.

COUNTRY OF ORIGIN AND NATURE OF NURSERY-STOCK IMPORTATIONS.

Country of origin and classes of plants and seeds imported during the year ended June 30, 1917.

Country.	Fruit trees.	Fruit-tree stocks.	Grape-vines.	Bush fruits.	Roses.	Rose stocks.	Forest and ornamental deciduous trees.	Ornamental deciduous shrubs.
Australia.....	137						35	50
Azores.....			15		52			
Belgium.....	25				400		1,851	40,990
Canada.....	1,346							31,000
Cuba.....							50	
Denmark.....								2,250
England.....	4,334	30,250	129	53,391	107,827	2,719,040	5,002	15,166
France.....	1,170,471	9,752,305	10	15,900	104,995	2,402,435	1,254,635	2,486,255
Holland.....	17,082	6,000		6,724	12,073,818	427,868	133,242	594,711
Ireland.....	100				85,053	150,000		613
Italy.....		246,500					12	
Jamaica.....								4
Japan.....	23,471	13,334			36	1	80,986	51,058
Philippine Islands.....						177,000	135	
Scotland.....	434		82	591	9,953		13,012	84
Total.....	1,217,400	10,048,389	236	76,606	12,382,134	5,876,344	1,488,960	3,202,181

Country of origin and classes of plants and seeds imported during the year ended June 30, 1917—Continued.

Country.	Coniferous trees other than pines.	Pines.	Ever-green trees.	Ever-green shrubs.	Field-grown florists' stock.	Stocks, cuttings, or seedlings.	Tree seeds.
							<i>Pounds.</i>
Argentine Republic.....					201		
Australia.....				1	242		28, 184
Azores.....				48			
Belgium.....	25, 943		8, 472	707, 772	31, 488	200	
Bermuda.....					15, 033	500	4, 010
Brazil.....					16, 648		26, 898
Canada.....	3		48		106	1, 000	2, 018
Canal Zone.....					350		
Colombia.....			2		60, 859		
Costa Rica.....					5, 057		
Cuba.....			10	100	43, 255	4	1, 314
Denmark.....					120		
England.....	6, 493		494	88, 756	41, 574	35, 687	5
France.....	476, 206		30, 535	137, 593	65, 937	7, 825, 815	54, 820
Guatemala.....			4		4, 047		
Holland.....	55, 816		8, 882	376, 200	178, 993	35, 751	
Honduras.....						72	
India.....					3, 000	45	
Ireland.....					1, 001	115, 000	
Italy.....					101		516
Jamaica.....				21	33		
Japan.....	16, 772	2, 213	1, 073	33, 758	91, 782	20, 087	2, 042
Java.....					16	100	
Mexico.....					2, 638		
New South Wales.....					195		8, 255
New Zealand.....			9	168	49		10
Panama.....					1, 750		
Philippine Islands.....					15, 338		
Samoa.....					24		
Scotland.....	212		14	458	19, 192	2, 400	
Society Islands.....						8	5
Trinidad.....				13, 000	6, 714		379
Venezuela.....					22, 000		
Total.....	581, 445	2, 213	44, 543	1, 357, 875	627, 743	8, 036, 669	128, 456

COTTON IMPORTATIONS.

The regulation of the importation of Egyptian and other cotton into the United States has continued under the order of the Secretary of April 27, 1915, to guard against the introduction of the pink bollworm and other injurious cotton insects.

The provisions of this order were extended November 4, 1916, to include cotton imported from the Mexican States of Nuevo Leon, Coahuila, Durango, Chihuahua, Tamaulipas, and Lower California, with the exception of the Imperial Valley, which States, prior to that date, had been excepted from the provisions of the regulations, and March 7, 1917, the regulations were further amended, effective July 1, 1917, to include also cotton grown in the Imperial Valley in the State of Lower California.

The board's attention having been called to the fact that practically all cotton waste, including those grades whose disinfection is not required as a condition of entry, is covered either wholly or partially with wrappings from cotton bales, and that these wrappings have adhering to them particles of raw cotton which may contain seed, thus leaving open an avenue for the entrance of the pink bollworm, the entry without disinfection of cotton waste was limited on January 1, 1917, to such waste as is free from all cotton seed and covered with wrappings not previously used to cover cotton, or with

American cotton bagging, commonly known as coarse gunny, which has been used to cover only cotton grown in the United States.

For a similar reason and on the same date the importation of burlap or other fabric which has been used, or of the kinds ordinarily used, for wrapping cotton was brought under restriction. All such material is now imported under permit. Disinfection, as a condition of entry, is required of all second-hand cotton wrappings except such as have been freed from adhering cotton and disinfected abroad by a process approved by this board, and American cotton bagging, commonly known as coarse gunny, which has been used to cover only cotton grown in the United States.

A new element of danger in connection with the possible introduction of the pink bollworm from Mexico was discovered in the fact that most Mexican cotton is inadequately hooped with iron over an insufficient wrapper of coarse sisal fiber netting, permitting considerable leakage or wastage in the process of unloading and handling on the docks, transporting to fumigation plants, and in storage pending and subsequent to fumigation. This state of affairs has been brought to the attention of all Mexican shippers exporting cotton to this country, and they have been advised that a continuation of the system of inadequate baling may necessitate the placing of further restrictions upon the importation of cotton from Mexico.

The entry of cotton and such cotton waste and burlap as require disinfection as a condition of entry is restricted to ports where facilities for the disinfection of cotton are available. At the present time such facilities exist at the ports of Boston, Mass.; New York, N. Y.; Newark, N. J.; and San Francisco, Cal. Since it is mechanically impossible for cotton seed to pass through carding machines, card strips and waste resulting from and subsequent to the carding machine may, if covered with wrappings which conform to the requirements of the regulations, be admitted without disinfection at any ocean port where the board maintains inspection service, including, in addition to the ports mentioned above, Philadelphia, Pa.; New Orleans, La.; and Seattle, Wash.

During the fiscal year, 944 permits for the importation of foreign cotton, cotton waste, and burlap, and 390 licenses authorizing the use of foreign cotton have been issued by the board.

The following table indicates the amount of cotton and cotton waste imported during the fiscal year and the amount of burlap imported from January 1 to June 30, 1917:

Cotton and burlap imported from July 1, 1916, to June 30, 1917, in bales.

Country of origin.	Ginned cotton.	Cotton waste.	Burlap.
Bahama Islands.....	6	.....	.....
Brazil.....	4	1	.....
Canada.....	.....	1,679	60
Canal Zone.....	.....	80	.....
China.....	33,788	2,884	.....
Colombia.....	3	150	.....
Cuba.....	.....	18	.....
Denmark.....	.....	27	242
Ecuador.....	20	.....	.....
Egypt.....	137,524	.....	.....
England.....	.....	19,451	20,377

Cotton and burlap imported from July 1, 1916, to June 30, 1917, etc.—Continued.

Country of origin.	Ginned cotton.	Cotton waste.	Burlap.
France.....		172	9,527
Haiti.....	8,344		
Holland.....			259
India.....	5,120		
Italy.....		8,802	37
Japan.....		8,645	
Mexico.....	2,236	890	63
New Caledonia.....	669		
Nova Scotia.....			22
Peru.....	27,256		
Portugal.....			207
Santo Domingo.....	182	20	
Scotland.....			2,031
Spain.....		214	1,538
Turks Island.....	8		
United States.....	1,177		
Total.....	216,337	41,033	34,363

With the exception of returned American-grown cotton in its original containers, and foreign cotton entered for immediate export and for immediate transportation and exportation, all imported ginned cotton is subject to the disinfection requirement. The above total for ginned cotton includes 1,161 bales of the former and 6,501 bales of the latter. Of the remaining 208,675 bales, 206,404 bales were fumigated on or before June 30, 1917.

Grades of waste resulting from and subsequent to the carding machine are not subject to the disinfection requirement. The above total for cotton waste includes 32,100 bales of such grades. The remaining 8,933 bales were waste originating prior to the carding machine, the fumigation of which is required unless immediately exported. Of these, 2,233 bales were exported and 6,699 bales fumigated on or before June 30, 1917.

Of the above total for burlap 3,274 bales required disinfection and were fumigated on or before June 30, 1917. No record was kept of burlap importations prior to January 1, 1917.

During the fiscal year 404 packages of samples of ginned cotton and 11 packages of waste were imported. The ginned cotton included 10 packages of returned American-grown cotton not subject to disinfection. The waste included 5 packages of waste originating with or subsequent to the carding machine and, therefore, not subject to the disinfection requirement. Of the ginned cotton and waste subject to disinfection, 392 packages were disinfected on or before June 30, 1917.

POTATO IMPORTATIONS.

The restrictions on importations of potatoes from the Dominion of Canada and Bermuda were removed, effective July 1, 1917.

At the same time restrictions were removed on importations for local use only from any foreign country into the Territory of Hawaii. A similar exemption was already in effect as to the Territory of Porto Rico.

In addition to Canada and Bermuda, potatoes may be imported, under proper certification and inspection at the port of entry, from the following countries: Denmark, Holland, Belgium, and Cuba. Provision has also been made for the importation of potatoes from the States of Sonora and Chihuahua, Mexico, and the island of Santo Domingo without foreign inspection and certification. Potatoes from Santo Domingo are permitted entry only through the port of New York, where they are inspected prior to entry. On account of the European war the importations from Europe have practically ceased.

STATE AND FEDERAL INSPECTION OF IMPORTED PLANTS AND PLANT PRODUCTS.

In the course of the examinations by State and Federal inspectors of imported nursery stock and other imported plants and plant products, some 259 different species of insects were intercepted, including one nest of the brown-tail moth from France, two egg masses

of the gipsy moth from France and Belgium, raspberry sawfly from France and England, the gold-tail moth from Holland, an undescribed weevil in avocado seeds from Guatemala, a flat-head borer in chestnut from Japan, 16 nests of "white tree Pierid" from France, and numerous scale insects from various quarters of the globe.

No less than 130 specific diseases of which the causative organism was identified were collected on imported plants. Some of the more important interceptions were citrus canker on pomelo from China, the so-called pineapple disease on sugar-cane from China, sclerotia in radish seed from Japan, and parasitic nematodes in the roots of fig from Spain, Iris from China, and Pimenta seed from Mauritius.

INSPECTION AT PLANT INTRODUCTION GARDENS.

All plant material distributed from Yarrow, Md., was repeatedly examined throughout the year, and a large percentage of it was also inspected at the time of shipment. All material shipped from Miami and Brooksville, Fla., was examined at the time of distribution, and all material for distribution at Chico, Cal., was examined at the time of digging by collaborators of the board.

PINEAPPLE AND BANANA INSPECTION IN HAWAII.

In connection with the fruit fly quarantine of Hawaii, a total of 256,855 bunches of bananas, 12,875 crates of pineapples, 190 lots of coconuts, and 49 crates of taro were inspected for fruit and melon fly infestation and certified for shipment to the mainland.

REGULATORY INVESTIGATIONS.

The regulatory investigations conducted by the board during this fiscal year have had relation to a new and important lepidopterous insect enemy of stone fruits, *Laspeyresia molesta*, probably introduced into several places in this country with flowering cherry trees from Japan; and, in cooperation with the Bureau of Entomology, inspections to determine the further spread of the gipsy and brown-tail moths in relation to the quarantine of the area infested by these insects, and some explorations in Mexico to determine the distribution in that country of the pink bollworm, and similar surveys in Texas in relation to the same insect, more fully discussed elsewhere in this report.

LIST OF CURRENT QUARANTINE AND OTHER RESTRICTIVE ORDERS.

QUARANTINE ORDERS.

The numbers assigned to these quarantines indicate merely the chronological order of issuance of both domestic and foreign quarantines in one numerical series. The quarantine numbers missing in this list are quarantines which have either been superseded or revoked. For convenience of reference these quarantines are here classified as domestic and foreign.

DOMESTIC QUARANTINES.

Date palms.—Quarantine No. 6, with regulations: Prohibits the interstate movement of date palms or date-palm offshoots from Riverside County, Cal., east of the San Bernardino meridian; Imperial County, Cal.; Yuma, Maricopa, and Pinal Counties, Ariz.; and Webb County, Tex.; except in accordance with

the rules and regulations prescribed in the Notice of Quarantine, on account of two injurious scale insects, to wit, the Parlatoria scale (*Parlatoria blanchardi*) and the Phoenicococcus scale (*Phoenicococcus mariatti*).

Cotton seed and cottonseed hulls.—Quarantine No. 9: Prohibits the importation of cotton seed and cottonseed hulls from the Territory of Hawaii on account of the pink bollworm.

Hawaiian fruits.—Quarantine No. 13, revised, with regulations: Prohibits the importation from Hawaii of all fruits and vegetables, in the natural or raw state, except in manner or method or under conditions prescribed in the regulations of the Secretary of Agriculture, on account of the Mediterranean fruit fly and the melon fly.

Sugar cane.—Quarantine No. 16: Prohibits the importation from Hawaii and Porto Rico of living canes of sugar cane, or cuttings or parts thereof, on account of certain injurious insects and fungous diseases of the sugar cane known to occur in these Territories.

Cotton.—Quarantine No. 23, revised, with regulations: Prohibits the movement of cotton from Hawaii to the continental United States, except in accordance with the regulations prescribed in the Notice of Quarantine, on account of the pink bollworm.

Gipsy moth and brown-tail moth.—Quarantine No. 27, with regulations: Prohibits the movement interstate to any point outside of the quarantined towns and territory, or from points in the generally infested area to points in the lightly infested area of stone or quarry products and of the plants and the plant products listed therein until such stone or quarry products and plants and plant products have been inspected by the United States Department of Agriculture and certified to be free from the gipsy moth or the brown-tail moth, or both, as the case may be. This quarantine covers portions of the New England States.

FOREIGN QUARANTINES.

Irish potato.—Quarantine No. 3: Prohibits the importation of the common or Irish potato from Newfoundland; the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales, and Ireland; Germany; and Austria-Hungary on account of the disease known as potato wart.

Mexican fruits.—Quarantine No. 5, as amended: Prohibits the importation of oranges, sweet limes, grapefruit, mangoes, achras sapotes, peaches, guavas, and plums from the Republic of Mexico, on account of the Mexican fruit fly.

Five-leaved pines, Ribes, and Grossularia.—Quarantine No. 7, as amended: Prohibits the importation from each and every country of Europe and Asia, and from the Dominion of Canada and Newfoundland of all five-leaved pines and all species and varieties of the genera *Ribes* and *Grossularia*, on account of the white-pine blister rust.

Cotton seed and cottonseed hulls.—Quarantine No. 8, as amended, with regulations: Prohibits the importation from any foreign locality and country, excepting only the locality of the Imperial Valley, in the State of Lower California, Mexico, of cotton seed (including seed cotton) of all species and varieties and cottonseed hulls, on account of the pink bollworm.

Seeds of avocado or alligator pear.—Quarantine No. 12: Prohibits the importation from Mexico and the countries of Central America of the seeds of the avocado or alligator pear, on account of the avocado weevil.

Sugar cane.—Quarantine No. 15: Prohibits the importation from all foreign countries of living canes of sugar cane, or cuttings or parts thereof, on account of certain injurious insects and fungous diseases of the sugar cane occurring in such countries. There are no restrictions on the entry of such materials into Hawaii and Porto Rico.

Citrus nursery stock.—Quarantine No. 19: Prohibits the importation from all foreign localities and countries of all citrus nursery stock, including buds, scions, and seeds, on account of the citrus canker and other dangerous citrus diseases. The term "citrus" as used in this quarantine includes all plants belonging to the subfamily or tribe *Citratoe*.

European pines.—Quarantine No. 20: Prohibits the importation from all European countries and localities of all pines not already excluded by quarantine on account of the European pine-shoot moth (*Evetria buoliana*).

Indian corn or maize and related plants.—Quarantine No. 24, as amended: Prohibits the importation from southeastern Asia (including India, Slam, Indo-China and China), Malayan Archipelago, Australia, New Zealand, Oceania, Philippine Islands, Formosa, Japan, and adjacent islands, in the raw or un-

manufactured state, of seed and all other portions of Indian corn or maize (*Zea mays* L.), and the closely related plants, including all species of Teosinte (*Euchlaena*), Job's tears (*Cotx*), *Polytoca*, *Chionachne*, and *Sclerachne*, on account of the downy mildews and *Physotheria* diseases of Indian corn, except that Indian corn or maize may be imported on compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

Citrus fruit.—Quarantine No. 28: Prohibits the importation from eastern and southeastern Asia (including India, Siam, Indo-China, and China), the Malayan Archipelago, the Philippine Islands, Oceania (except Australia, Tasmania, and New Zealand), Japan (including Formosa and other islands adjacent to Japan), and the Union of South Africa, of all species and varieties of citrus fruits on account of citrus canker, except that oranges of the mandarin class (including satsuma and tangerine varieties) may be imported on compliance with the conditions prescribed in the regulations of the Secretary of Agriculture.

OTHER RESTRICTIVE ORDERS.

Nursery stock.—In addition to nursery stock, the entry of which was brought under regulation with the passage of the plant-quarantine act of August 20, 1912, orders have been issued by the Secretary of Agriculture regulating the entry of potatoes, avocados, cotton, corn, cottonseed products, and citrus fruits, under the authority contained in section 5 of this act.

Irish potato.—The order of December 22, 1913, covering admission of foreign potatoes under restriction, prohibits the importation of potatoes from all foreign countries, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of injurious potato diseases and insect pests. The regulations issued under this order have been amended so as to permit, free of any restrictions whatsoever under the plant-quarantine act of August 20, 1912, the importation of potatoes from any foreign country into Hawaii and Porto Rico for local use only and from the Dominion of Canada and Bermuda into the United States or any of its Territories or Districts.

Avocado or alligator pear.—The order of February 27, 1914, prohibits the importation from Mexico and the countries of Central America of the fruits of the avocado or alligator pear, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of the avocado weevil. Entry is permitted only through the port of New York and is limited to the large, thick-skinned variety of the avocado. The importation of the small, purple, thin-skinned variety of the fruit of the avocado, and of avocado nursery stock under 18 months of age, is prohibited.

Cotton.—The order of April 27, 1915, prohibits the importation of cotton from all foreign countries and localities, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of injurious insects, including the pink bollworm. These regulations apply in part to cotton grown in and imported from the Imperial Valley, in the State of Lower California, in Mexico.

Corn.—The order of March 1, 1917 (Amendment No. 1, with Regulations, to Notice of Quarantine No. 24), prohibits the importation of Indian corn or maize in the raw or unmanufactured state from the countries and localities listed in Notice of Quarantine No. 24, except under permit and in accordance with the other provisions of the regulations issued under said order, on account of injurious diseases of Indian corn.

Cottonseed products.—The order of June 23, 1917, prohibits the importation of cottonseed cake, meal, and all other cottonseed products, except oil, from all foreign countries, and a second order of June 23, 1917, prohibits the importation of cottonseed oil from Mexico, except under permit and in accordance with the other provisions of the regulations issued under said orders, on account of injurious insects, including the pink bollworm.

Citrus fruits.—The order of June 27, 1917 (Notice of Quarantine No. 28, with Regulations), prohibits the importation from the countries and localities listed therein of all species and varieties of citrus fruits excepting only oranges of the mandarin class (including satsuma and tangerine varieties) on account of the citrus canker disease. Oranges of the mandarin class (including satsuma and tangerine varieties) may be imported under permit and in accordance with the other provisions of the regulations issued under said order.

REPORT OF THE CHIEF OF THE BUREAU OF MARKETS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF MARKETS,
Washington, D. C., September 15, 1917.

SIR: I have the honor to transmit herewith a report of the work of the Bureau of Markets for the fiscal year ended June 30, 1917.
Respectfully,

CHARLES J. BRAND,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

On July 1, 1917, the Office of Markets and Rural Organization became the Bureau of Markets. Several lines of work which previously had been conducted elsewhere in the department were merged with the bureau's work, and several new lines were begun as provided for in the Agricultural appropriation act for the fiscal year 1918. For the sake of clearness and for future use, this report is drawn in accordance with these fiscal changes.

During the fiscal year the work has gradually divided into three main groups not clearly defined last year: (1) Investigational and demonstrational work; (2) service; and (3) regulatory work. In the first group are classified the investigations in marketing and distributing farm products, food supply investigations, cooperation with States in marketing work, rural organization investigations, investigation of cotton standards and cotton testing, and grain standardization investigations. In the second group belongs the work of issuing the several kinds of market reports to be mentioned in detail later. In the third group is classified the administration and enforcement of the United States cotton futures act, the United States grain standards act, the United States warehouse act, and the United States standard container act.

INVESTIGATIONAL AND DEMONSTRATIONAL WORK.

The investigational and demonstrational work includes the projects reported under this heading last year, with several others which have been developed since that time. Most of these projects relate to the marketing and distribution of farm products.

MARKETING AND DISTRIBUTION OF FARM PRODUCTS.**COOPERATIVE PURCHASING AND MARKETING.**

Plans for the formation of marketing organizations and the re-organization of existing associations have been furnished producers of all kinds of farm products in various parts of the United States. Specific help has been rendered in several typical sections as a demonstration.

The study of farmers' purchasing and marketing associations has been continued. New names have been added to the lists and information has been secured from a large number of organizations. The material secured has been used as a basis for the preparation of Department Bulletin 547, Cooperative Purchasing and Marketing Organizations among Farmers in the United States.

In cooperation with the Office of the Solicitor the draft of a proposed State cooperative law was completed and published in Service and Regulatory Announcements No. 20: Suggestions for a State Cooperative Law Designed to Conform to Section 6 of the Clayton Act.

The work on cooperative purchasing and marketing is under the direction of Mr. C. E. Bassett.

MARKET BUSINESS PRACTICE.

The use of systems and methods devised and published by this bureau has been extended among grain elevators, live stock shipping associations, fruit and produce associations, and cooperative stores, under the direction of Mr. John R. Humphrey.

ACCOUNTING RECORDS FOR COUNTRY CREAMERIES.

The uniform system of accounts for country creameries which was in an experimental stage during the past year was completed and submitted for publication as Department Bulletin 539, Accounting Records for Country Creameries. The system is now in operation in ten creameries, and is rapidly being installed in many others. The Federated Creameries Association, of Grand Rapids, Mich., has adopted this system for use in 50 creameries in that State, and numerous requests to install it are being received from various parts of the country.

Investigations relating to creamery accounting and business practice have shown that the creamery business is in great need of assistance in these matters. The diversity of present methods employed in financing creameries, some of which are very involved, and the general lack of knowledge regarding the keeping of books for a business which includes manufacturing problems, will give this system of accounting a prominent place among the systems devised by this bureau. Constructive assistance is rendered by representatives of the bureau wherever the system is installed.

SYSTEM OF ACCOUNTING FOR FRUIT ASSOCIATIONS.

Closely following the formation of the Fruit Growers' Agency (Inc.), under which the shippers of the Pacific Northwest, comprising the States of Washington, Oregon, Idaho, and Montana, associated themselves for the purpose of carrying out the provisions of

the uniform contract, representatives of the bureau were detailed to study the accounting problems of the organizations in that section.

Preparatory to beginning the work looking toward the standardization of the accounting records of the shipping organizations, personal visits were made to 37 associations located in the States of Washington, Oregon, Idaho, Colorado, and Utah, and the systems of accounting in their offices were examined. Samples of the accounting forms were procured and the business practices of these organizations were studied carefully.

Uniform account sales.—Under the provisions of the uniform contract adopted by the Fruit Growers' Agency (Inc.), the members agreed to the use of a uniform account sales in reporting the proceeds of the sales of the fruit to their grower members. In cooperation with the committee on business practice of the Fruit Growers' Agency (Inc.), a form of account sales was devised which was adopted by 20 organizations, representing approximately 85 per cent of the membership of the agency.

Division of sizes.—Prior to the completion of the uniform account sales it was necessary to take up the study of the relative values of the various sizes of apples in the recognized grades and to group these sizes in order to reduce clerical labor to allow for the introduction of the account sales and the publication of the averages of returns on a uniform basis.

The system of accounting for fruit-shipping associations was devised and installed in eight concerns for experimental operation. Close supervision was given in order to note any opportunities for improving the forms or the procedure under which they were operated. Since the conclusion of the experimental operations the system has been adopted by 10 other organizations.

Special forms were also devised to accommodate the peculiar needs of the system of packing by weight which was in operation at packing houses at Entiat, Wash., during the 1916-17 season.

The matter of the pooling of returns made to the growers by the shippers for the fruit handled by them was studied, and recommendations were made in regard to the general pooling methods, the closing of the pools, and the treatment of the miscellaneous varieties. In order to note the possibilities of the establishment and use of an established differential for grades and size groups of the various varieties of apples, this method of pooling was given a trial for experimental purposes by 10 organizations in the Wenatchee district. Results were satisfactory and other sections have signified their intention of using the method during the approaching season.

A schedule of rules for the uniform classification of returns for publication of average prices was drawn up and adopted by the Fruit Growers' Agency (Inc.), for the guidance of its members in the publication of average prices.

FRUIT PACKING-HOUSE COSTS.

Investigations were conducted at eight organizations for the purpose of ascertaining the cost of operations in fruit packing houses and warehouses. These findings are still incomplete, but it is expected that they will be finished during the next season.

COMMISSION HOUSE ACCOUNTING.

Investigations and studies conducted with a view to standardizing methods and accounts and for an improvement in general business procedure in commission houses have been continued in all of the principal cities of the States of New York, Massachusetts, Pennsylvania, Ohio, Illinois, Indiana, Michigan, Minnesota, Iowa, Missouri, Nebraska, Kansas, Louisiana, and Texas. The trade in general seems to be in hearty accord with the object of the work and has extended opportunities for study in as full a manner as consistent with the natural limitations which affect the type of business. Accounting committees were appointed by the National League of Commission Merchants and the Western Fruit Jobbers Association, with direction and authority to cooperate to the best of their ability with the Bureau of Markets in perfecting a uniform system of accounts. When the system has been finally effected and is ready for adoption, it is expected that these committees will recommend its use to the members of the above associations. The investigational activities have practically been completed and tentative forms have been installed for experimental purposes in representative houses located in Philadelphia, Pittsburgh, Detroit, and St. Louis.

AUDITING ASSOCIATIONS.

Auditing associations have been formed in North Dakota and Kansas. The Bureau of Markets has rendered assistance to these associations by drawing up model by-laws and in both cases helping in the organization. These auditing associations are formed for the purpose of conducting periodic audits for all business associations holding membership, with the object of limiting the annual expense for this service and of securing comparative statistics in similar lines of business operation. The Auditing Association of Kansas has enlisted 225 members. Auditing associations, if properly conducted, may serve not only as a committee of audit, but also as a centralized business reference bureau wherein the managers of various business units may receive valuable advice and assistance.

COTTON WAREHOUSE ACCOUNTING.

In connection with the warehouse investigations reported elsewhere, a system of accounts for cotton warehouses has been devised and issued as Department Bulletin 520, A System of Accounts for Cotton Warehouses. Indications are that the system will probably be installed in many cotton warehouses in the South.

MARKET SURVEYS, METHODS, AND COSTS.

Most of the work conducted under this project, which is under the leadership of Mr. Wells A. Sherman, is in direct connection with the market news service on fruits and vegetables reported elsewhere. The following lines of investigation are among those which have been developed.

MAIL REPORTS OF SHIPMENTS.

The reports of carload movement of fruits and vegetables in the United States have been continued and extended. Eighty commodities are now covered, and it is estimated that these reports represent from 75 to 80 per cent of the total movement of fruits and vegetables in this country.

MARKET PREFERENCES.

Investigators and the progressive element of the trade have always been convinced of the importance of market preferences in marketing and distributing perishable fruits and vegetables. These preferences have developed largely through custom, and yet it is unwise for a shipper to disregard market preferences in placing upon the market varieties, packages, or grades other than those to which the consuming public in a given city or territory is accustomed. A study is under way covering the following commodities: Apples, potatoes, peaches, onions, cantaloupes, tomatoes, grapes, sweet potatoes, and grapefruit, as it was felt that the markets have developed distinct preferences on these commodities. The points upon which information was secured included the demand in each city for varieties, colors, sizes, grades, and packages.

CONSUMING CAPACITIES OF DIFFERENT MARKETS.

Records have been collected in 12 cities on 12 commodities, and in 20 cities on 8 of these commodities, which will form the basis for an interesting and useful further statistical study of consuming capacities of different markets. The records already collected are being tabulated and placed in shape for future use.

METHODS OF MARKETING

A study has been made of the prevailing methods of marketing employed in the most important producing regions for peanuts, beans, and potatoes, as well as the distribution of Northwestern boxed apples, as shown by detailed figures secured during two marketing years. The detailed records of receipts and prices have been continued and the list of commodities covered has been extended.

During the year two publications have been issued as a result of these marketing investigations, Department Bulletin 401, Marketing and Distribution of Western Muskmelons in 1915, and Department Bulletin 477, Marketing and Distribution of Strawberries in 1915.

MARKET GRADES AND STANDARDS.

Under the joint direction of Mr. C. T. More and Mr. W. M. Scott, the grades and standards work has been extended to cover more territory and additional crops, including a more detailed study of fruit and vegetable packing houses and packing-house equipment, and the effect of different methods of handling upon the physical condition of the fruit. Also, experimental and demonstrational inspection work has been conducted to encourage better handling methods and to facilitate the marketing of certain crops.

FRUIT AND VEGETABLE GRADING AND HANDLING.

Exhaustive studies have been made of the grading and handling of apples, peaches, and strawberries, and practical tentative grades have been worked out for these crops. The work has covered the principal producing sections of the East, South, and Middle West, and also the more important markets. It has included grading, packing, packages, packing house construction and equipment, and the effect of different methods of handling upon the physical condition of the fruit. The operation of sizing machines and other labor-saving devices was studied to determine their efficiency and practicability. As a result of the work the bureau is now prepared to make definite recommendations as to grading and packing these crops, as to fruit packing house plans and equipment, and general handling methods.

Special attention has been given to potatoes, Texas Bermuda onions, cantaloupes, and tomatoes, and work has been started on other truck crops, consisting of a study of the various operations of harvesting, grading, packing, inspecting, and shipping. As a result of this work the Bureau of Markets was able to recommend immediately, in conjunction with the United States Food Administration, on the request of the Federal Reserve Board, potato grades for use by the member banks, when, in August, 1917, they were authorized to make loans against warehouse receipts for potatoes, properly graded, packed, stored, and insured. These grades were published as Markets Document 7.

The tentative grades worked out in 1916 were put to a practical test by being used as a basis for the actual field grading of car lots of onions and potatoes, with comparison of the movement and selling price of graded stock with that of stock which had not been graded.

Experiments have been made to determine the efficiency and practicability of machinery for sizing these crops. It was demonstrated that the work may be done economically and with more uniform results by the use of machines than by the hand method.

STANDARDIZATION OF GRADES AND PACKAGES.

Investigations were made to determine how successfully apple grade laws are being carried out in the several States having such laws and to obtain the necessary information upon which uniform grade legislation may be based. At the request of various growers' associations and horticultural societies of 12 States, a specimen bill, embodying grade specifications, marking requirements, and other essentials, was prepared for use as a guide in drafting proposed legislation. Three of these States have adopted the essential provisions of this bill by legislative enactment and two others have amended existing laws to conform closely with it.

Extensive losses were found to have been sustained by growers, shippers, receivers, and the transportation companies because of the frail condition, or careless construction, of fruit and vegetable containers. Great confusion and some deception were found on the market, especially in selling and in reporting market prices, because of the wide variation in types and sizes of packages used by different growers for the same articles. In addition to the package investigations conducted, conferences have been held with growers,

shippers, package manufacturers, and officials of transportation companies in the interest of standard packages, better-made packages, and better loading of cars. Work under the United States standard container act is reported under the regulatory work of the bureau.

MARKET INSPECTION OF FRUITS AND VEGETABLES.

At the request of growers, shippers, and associations, a cantaloupe inspection service was conducted in the Rocky Ford-Ordway section of Colorado during the shipping season of 1916. Its purpose was to put into effect grading and handling methods which had been previously worked out by the Bureau of Markets.

During October, November, and December an experimental inspection of boxed apples from Northwestern States and Colorado, destined to and through Fort Worth, Tex., was conducted. This inspection covered the condition of the fruit upon arrival at Fort Worth and the efficiency with which it had been handled, graded, and packed. The purposes were to determine the feasibility of such an inspection system, the methods to be employed, and the difficulties to be encountered, and, incidentally, to obtain for the shippers information concerning the condition and quality of their fruit upon arrival at destinations.

APPLE PACKING HOUSES IN THE NORTHWEST.

In the Pacific Northwest during the apple-picking season of 1916, an investigation of packing-house plans, equipment, and management was conducted, the purpose being to determine the best and most economical methods of handling apples from the orchard through all the packing-house operations to the car. The studies were made in 60 packing houses including community houses, commercial houses, and ranch houses. Sizing machines were tested for accuracy and efficiency, and the various handling methods were compared as to their economy, efficiency, and effect upon the physical condition of the fruit. Special attention was given to the arrangement of the floor space for convenience and the elimination of lost motion and to the use of equipment for saving labor. A preliminary report on the work was published as Markets Document 4, Preliminary Report on Apple Packing Houses in the Northwest.

TRANSPORTATION AND STORAGE.

As reported last year, the great value of the transportation section of the bureau, under the leadership of Mr. G. C. White, lies in its function of a traffic department for the bureau as a whole. Through this section the bureau has secured the cooperation of 367 railroads, 6 express companies, and 6 boat lines in sending fairly prompt and accurate reports of the shipping of fruits, vegetables, and live stock, for use in the reporting services described elsewhere.

LOSS OF FOODSTUFFS IN TRANSIT.

The Nation's program of food conservation accentuates the importance of the work in cooperation with the railroads, reported as in progress last year, for the prevention of the loss of foodstuffs in

transit. Adequate refrigeration and adequate heating of cars both play a part in the conservation of foodstuffs, and the possibilities of both have been studied with this in view. The experience of potato shippers during the winter of 1916-17 emphasizes the need of some efficient method of protecting against cold, cars loaded with perishable foodstuffs in the winter season. Pending the adoption and installation by the railroads of efficient and economical equipment, efforts are now directed toward securing the greatest cooperation of the carriers for the utilization to the best possible advantage during the coming winter of existing methods of protection by the use of heat.

STORAGE.

Studies are being made of proper methods of construction of both cold and common storages, practical equipment, and methods. Detailed and exhaustive inquiry has been made into the stocks of certain foodstuffs in storage, and from these investigations a reporting service has been built up which is described elsewhere.

Reports received from packers and other cold-storage houses at the end of the fiscal year show a total of 181,259,981 cubic feet of storage space in service by the packing houses, and a total of 184,189,815 cubic feet controlled by other cold-storage houses, or a total available storage space for the entire country of 365,449,796 cubic feet. This information is classified in accordance with the temperatures at which various rooms are held. The houses reporting show a total of 27,466,125 cubic feet planned for construction in the near future.

From investigations by this bureau the value of the cold-storage houses throughout the country is estimated at \$90,000,000, and it is believed that the average aggregate value of foodstuffs stored in them at any given time is not less than \$375,000,000.

CITY MARKETING AND DISTRIBUTION.

Because of the abnormal prices of foodstuffs, there has been an unusually heavy demand from municipalities for aid in solving local marketing problems. Interest in public markets of all kinds has been keen, but because of the high cost of construction work most cities with which the bureau has cooperated have had to forego inclosed market buildings and start with the inexpensive farmers' market. This type of market, while simple in character, under proper management and regulation can be made a most valuable asset to almost every city. It not only is the best medium of direct marketing that has been devised, but by furnishing a steady and dependable outlet to local producers, it develops in a most effective way a greater near-by food production. It is also proving to be the most efficient agency for the distribution of surplus home garden products.

SERVICE WORK FOR CITIES.

In answer to requests from city officials or responsible civic organizations, surveys have been made during the past fiscal year in Roanoke and Norfolk, Va.; Vincent-Salem, Charlotte, and Raleigh, N. C.; Greenville, S. C.; Cumberland, Md.; Butler and Wilkes-Barre, Pa.;

Niagara Falls, Rome, Binghamton, and Elmira, N. Y. These studies have been followed by advisory aid in improving conditions.

In cooperation with the Lynchburg Chamber of Commerce and the Virginia Bureau of Markets an extended city marketing survey was made at Lynchburg, Va. Outgoing and incoming shipments of food products of the past year were tabulated to ascertain what crops should be raised in greater abundance locally in order to make the county more nearly self-supporting. A study was made of the local public markets, and detailed advice was given for feasible market improvements.

MARKET ENGINEERING WORK.

Investigations relating to the construction of various kinds of public markets and wholesale terminal produce markets have been continued throughout the year. Suggested rough plans and estimates for market buildings, varying in detail and completeness, were prepared for the following cities: Roanoke and Norfolk, Va.; Winston-Salem, N. C.; Butler and Wilkes-Barre, Pa.; and Niagara Falls, N. Y.

Work has been continued upon the preparation of standard model plans for various types of public markets and produce terminals. Designs have been completed for steel, timber, and concrete sheds for farmers' markets and for a knockdown structural steel shelter for protection in connection with a retail curb market. An improved layout for an inclosed retail public market building has been finished in which special attention has been given to the proper handling of live poultry and fish. In connection with the work on terminal markets, an efficient plan for a wholesale produce rail terminal, combined with a layout for a wholesale farmers' market, has been prepared, the general principles of which must be adopted eventually if our cities are greatly to improve their marketing facilities. Original designs of a refrigerated display and storage counter for meats and fish, and of a sanitary and attractive fruit and vegetable counter, for public markets, have been made, and units are being built to be tested under practical conditions. All the city marketing work is under the direction of Mr. G. V. Branch.

MARKETING BY PARCEL POST AND EXPRESS.

The general aim of the parcel-post work, conducted by Mr. L. B. Flohr and his assistants, has been to ascertain, analyze, and classify the factors that operate for or against the successful marketing by parcel post or express of farm produce from producers direct to consumers; to determine definitely the limitations of direct marketing, both from physical and economic standpoints; and to give useful information to interested persons.

Experimental shipments of a wide variety of commodities have been continued. They have demonstrated that in nearly every case the success of a shipment depends on the quality of the product shipped, the type of container, and the care used in packing. The value of a commodity in proportion to its weight, and the price which

can be obtained by marketing through other channels are factors in determining the desirability of direct marketing.

Field studies have been made in the vicinity of Seattle, Wash.; Portland, Oreg.; San Francisco and Los Angeles, Cal.; St. Louis, Mo.; Dallas, Galveston, Houston, San Antonio, and Austin, Tex.; Greenville, S. C.; Pittsburgh, Pa.; and Syracuse, N. Y. These studies were made in order to determine further the possibilities of marketing direct from producers to consumers, and to ascertain the relative success of efforts that have been made to popularize direct marketing either by parcel post or express. The information thus obtained, based as it is on actual experience and observation, is much needed, and the diffusion of such information should be of assistance to people throughout the country.

Farmers' Bulletin 594, *Shipping Eggs by Parcel Post*, has been revised and issued as Farmers' Bulletin 830, *Marketing Eggs by Parcel Post*.

COTTON HANDLING AND MARKETING.

Studies and demonstrations relating to cotton handling and marketing are conducted under the supervision of Mr. Fred Taylor. Most of the work forms a continuation of that reported last year.

COOPERATIVE HANDLING AND MARKETING OF COTTON.

The studies in Arkansas, California, and North Carolina have been continued and results have been checked with those of 1916. They have shown definitely that when farmers knew the grade and staple of their cotton before sale, better prices were obtained. Details have been published in Department Bulletin 476, *A Study of Cotton Market Conditions in North Carolina with a View to their Improvement*, and in Department Bulletin 458, *Handling and Marketing Durango Cotton in the Imperial Valley*. This work has been extended into the States of Georgia, Oklahoma, South Carolina, and Texas, special effort being made everywhere to demonstrate the desirability and practicability of knowing the grade and staple of cotton before sale by farmers, the value of selling in even-running lots of grade and staple, the disadvantage of short-staple varieties, and their effect on the average price paid for the cotton of the community.

An investigation was made to determine whether cotton could be accurately classed with samples drawn during the process of ginning. Comparisons were made with tests involving 8,026 bales by classing independently samples drawn during ginning and samples cut from the bale. Much variation was found between the grades of the samples from identical bales, while the average grade of the two entire lots of samples was found to be very similar. In order to verify the results of this test, and to form a basis for possible recommendation, further work will be necessary.

Incidental to work conducted with gins Farmers' Bulletin 764 was published under the title of *Cotton Ginning Information for Farmers*.

STUDIES IN PRIMARY MARKETING.

Studies were made in selected primary markets with a view to securing data which would form a basis for assistance in improving present marketing conditions. The studies included the value of a knowledge of grade before sale, the effect of staple upon the average price of a market, the value of growing a uniform variety, cooperative marketing of cotton, selling cotton in even-running lots of grade and staple, and a comparison of prices paid in various primary markets. Results were used to check observations which had previously been made in primary markets and were published in Department Bulletin 457, Relation between Primary Market Prices and Qualities of Cotton.

STUDIES OF STAPLE.

The long-staple survey begun in 1916 in those sections which produce cotton of $1\frac{3}{8}$ inches in length of staple or longer was continued during 1917. The objects were to determine the premiums received by producers for the different lengths, the relative qualities of long-staple cotton produced in different sections, and the general conditions under which the crop was marketed. During 1917 there were collected 4,769 samples, together with prices and dates of sales, from 23 markets. They have been classed and the data are being compiled. The results are of especial value in connection with the investigations regarding the possibility of establishing official cotton standards of the United States for length of staple.

The Sea Island survey begun in 1916 was continued during 1917. The objects were to determine the varying qualities of the cotton, the prices received by the producers, and general information relating to the handling and marketing of this crop. During the cotton season of 1916-17 there were secured 2,019 samples, together with prices and dates of sales. The samples have been classed and the data are being compiled. Types have been obtained from different commercial firms representing their ideas as to proper standards for sea-island cotton.

COTTON WAREHOUSING INVESTIGATIONS.

The cotton warehousing investigations have been continued under the direction of Mr. R. L. Nixon.

The work of obtaining information in regard to the location, name, capacity, construction, cost, insurance rate on stored cotton, charges for storage, whether loans can be secured on stored cotton, and interest rates has been continued, and reports from many warehouses that did not report previously have been received. This additional information has been incorporated in the tabulations and outline maps already established. The lists of warehouses have been revised frequently and changes made in order to keep the lists up to date.

The system of accounts for cotton warehouses reported previously includes simple and adequate forms for keeping the accounts and records of cotton warehouses. The forms of warehouse receipts which are shown in connection with the system have been designed with the idea of increasing their negotiability and value as collateral. It is hoped that the distribution of the bulletin, together with the

printers' forms, will have a tendency to bring about uniformity of receipts, standardization in methods of keeping accounts, and improvement in the general business methods of cotton warehouses.

The study of State warehouse laws has been continued. Conferences have been held and advice given to State officials in regard to proposed warehouse laws. Work under the United States warehouse act is reported under the regulatory activities of the bureau.

MARKETING COTTON SEED AND ITS PRODUCTS.

Under the supervision of Mr. Fred Taylor, studies in the marketing of cotton seed and its products have followed three definite lines.

STUDIES OF ECONOMIC CONDITIONS OF THE INDUSTRY.

A thorough study is being made of the conditions surrounding the cottonseed industry. Such phases are included as the railroad movements of seed, the percentage of seed purchased directly from the farmer, and the percentages of foreign matter, oil, meal, hulls, and linters contained in commercial lots of seed in various sections. It is generally conceded that probably the most serious of the bad practices existing in the marketing of cotton seed are the large amount of trash which, annually, is purchased with cotton seed, and the practice of buying cotton seed on a basis of averages which now prevails to a considerable extent. Enormous aggregate charges in freight and handling expenses, wear on cleaning machinery, and danger to the health of workmen in the oil mills result each year from the presence of foreign matter in cotton seed which should be eliminated at the cotton gin.

COTTONSEED STANDARDIZATION.

As a means toward the elimination of wastes and the improvement of marketing, the feasibility of establishing practical grade standards for cotton seed has been investigated. Many data have been secured and tentative standards have been formulated.

A circular letter suggesting a basis of standardization and soliciting the views of the trade has been sent to all oil mills, as well as many producers and seed merchants, and it has been found that a general desire for the standardization of cotton seed prevails. Representatives of this bureau have attended the annual convention of the Interstate Cotton Seed Crushers' Association, as well as the conventions of the several State crushers' associations, and conferred with committees and members of those bodies regarding practical standards for cotton seed. As a result of these conferences, a basis of standardization has been officially adopted and incorporated in the official rules of various associations.

COTTON LINTERS INVESTIGATIONS.

The conditions existing in the handling and marketing of linters have been investigated, special attention being given to the different qualities of linters and to the practicability of standardizing this commodity. Owing to the great demand for linters as munition stock, the oil mills have increased the cutting of linters from about

50 pounds to about 150 pounds per ton of cotton seed. The mattress, batting, and felt makers, as well as other manufacturers who have used linters in the past, have abandoned this product to a large extent, on account of its present high prices and low quality. Thus practically the entire production of linters is being used for munition purposes.

MARKETING LIVE STOCK, MEATS, AND ANIMAL BY-PRODUCTS.

While all of the lines of work reported last year have been either completed or continued, general investigational work has necessarily been subordinated to the development of the market reporting services on live stock and live-stock products, which are described elsewhere. Both the investigational work and the reporting service are under the direction of Mr. L. D. Hall.

CONTINUED INVESTIGATIONS.

Work regarding cooperative live-stock shipping associations has progressed, particularly in Arkansas, Louisiana, and Tennessee. The study of centralized live-stock markets has continued and a number of packers' concentration points, feeding and finishing stations, and transfer points near centralized markets have been located. The study has included the tracing of actual shipments to centralized markets of cattle and hogs, including cost of driving and hauling to shipping points, methods and cost of bedding and loading cars, methods and costs of handling and feeding at market points, loss, damage, and shrinkage in transit. Further studies have been made of municipal abattoirs and of cooperative meat-packing companies.

The work relating to wholesale slaughtering and distribution of meats has been continued along the lines previously reported and has been extended to include the great meat-packing centers of the Middle West. Attention has been given to the study of market classifications and quotations of wholesale meats and meat food products. Slaughter tests were made on certain lots of live stock, followed by studies of the distribution of the meat products and by-products resulting therefrom.

Field investigations and demonstrations in general and local methods of marketing live stock have been conducted in Arkansas, Louisiana, South Carolina, Vermont, southwestern Virginia, and the San Juan Basin of Colorado. Prevailing methods and costs of marketing, relative efficiency of different methods, marketing facilities, and feasible remedies for existing marketing evils are included in the studies. Farmers' Bulletin 809, *Marketing Live Stock in the South*, has been published.

MARKETING WOOL.

The services of a specialist in marketing wool were secured near the end of the fiscal year, and preliminary investigations relative to the marketing of wool in the United States were undertaken, the principal feature of this work being the compilation of available data and of trade directories. The development of a current market information service, which also was inaugurated, is reported under Service.

MARKETING DAIRY PRODUCTS.

Investigations of the various phases of marketing dairy products have been continued, particular attention being given to the producers' or primary marketing problems. A number of special surveys of local marketing conditions and methods were made for the purpose of analyzing the local marketing problems and of suggesting methods for their improvement. The dairy marketing work is supervised by Mr. Roy C. Potts.

BUTTER AND CHEESE MARKETING.

Data obtained in the butter marketing surveys conducted during the previous year have been summarized and issued as Circular 66 of the Office of the Secretary, Suggestions for the Manufacture and Marketing of Creamery Butter in the South; and in Department Bulletin 456, Marketing Creamery Butter. Preliminary work has been carried on with more than 300 creameries looking toward the issuing of weekly reports of the production of creamery butter in the United States.

Investigations of all phases of cheese marketing have been extended to include all of the important distributing markets and leading producing sections of the United States and Canada.

MILK MARKETING.

A general survey of the market milk business of 40 of the larger cities of New England, Eastern, and Middle Western States has been made and data have been secured from more than 75 cities in all parts of the United States regarding the methods of gathering and distributing the milk supplies of these cities.

A general survey of the dairy marketing conditions in New Hampshire was made in cooperation with the extension division of the New Hampshire Agricultural College, and a report of this survey, now in press, has been published as a bulletin of the New Hampshire Experiment Station. Other milk marketing surveys were made in Windham County and Sussex County, N. J., at Cumberland, Md., and at Dubois, Pa.

A bulletin entitled "The County Milk Station—Its Function, Organization, Operation, Construction, and Equipment" has been prepared in cooperation with the dairy husbandry department of the New York State College of Agriculture for publication by the New York State College.

Plans are being formulated for the establishment of a market news service for dairy and poultry products, which will be carried on in connection with the similar service on live stock, meats, and animal by-products, through market field representatives of the bureau stationed in the larger and more important distributing markets and in the producing dairy districts.

GRAIN, HAY, AND SEED MARKETING INVESTIGATIONS.

The plans for the work relating to grain, hay, and seed marketing, which are being developed under Mr. George Livingston, Mr. K. B. Seeds, and Mr. W. A. Wheeler, include a careful and detailed eco-

conomic study of grain, hay, and seed marketing at producing centers and large central markets, and of their further sale to the consuming public. The information thus obtained should be useful to the various agencies engaged in marketing and distributing such products, and it should suggest constructive methods of improving the service. Heretofore the work has been confined largely to grain marketing problems, but during the past fiscal year it has been broadened to include active work with both hay and seed marketing.

MARKETING GRAIN AT COUNTRY POINTS.

The general study of the grain handling methods practiced at country shipping points, as affecting all branches of the grain trade, which has been carried on since the inauguration of this work, has resulted in the publication of Department Bulletin 558, Marketing Grain at Country Points. It is believed that the information so accumulated, which will be placed at the disposal of the producers and shippers of grain throughout the country, will prove of material assistance to them by bringing to their attention knowledge of the conditions and practices prevailing in the marketing of grain at country points.

TERMINAL MARKET PRACTICE.

The terminal marketing investigations undertaken during the past fiscal year have included the organization of boards of trade and chambers of commerce, the uniformity and equity of trade rules, terminal charges, methods of weighing, inspection and grading charges, and the services rendered by brokers, track buyers, warehousemen, and others engaged in the handling of grain at terminal markets. This work has been conducted with a view to determining the relation of the different practices to the problems of distributing the grain crop of the country, to the end that abuse and unfair procedure may be eliminated and uniform and economic conditions prevail. As a result of this and other work of the bureau, inspection and grading charges heretofore assessed have been lowered in many instances and made the same for all for whom the services are performed. The practice of assessing brokerage charges at fixed rates per bushel also has been changed at practically all markets to a percentage basis, at the suggestion of the Department of Agriculture, and the result has been highly satisfactory to all members of the trade.

MARKETING GRAIN AND HAY IN THE EAST AND SOUTH.

The work heretofore undertaken in the East and South has been continued. Studies have been conducted of the functions performed by exchanges, jobbers, brokers, and retailers; cost of distribution; difference between wholesale and retail prices, cash and credit transactions, delivery and door prices. Contact has been maintained with the conditions existing in all sections with reference to the marketing of grain and hay.

Particular attention has been given to hay-marketing activities in the East and South, though this phase of the work has been extended

to cover some few markets in the Central States. Investigations of the handling of the crop from the time of leaving the producer to its sale to the consumer have been conducted, and information acquired regarding the class of products demanded at each of the large markets, the fees charged, and the practices followed among the trade with reference to the inspection, weighing, storing, handling, grading, and sale of the product. The standards for inspection and grading of hay at all points have been studied carefully and the standards and rules in effect compiled for use in the preparation of uniform standards.

SEED-MARKETING INVESTIGATIONS.

Investigations of the practices followed in the marketing of seed throughout the largest field-seed producing section of the United States have been undertaken. Comparisons of prices in the different sections paid to producers at country points have been made and recorded, as well as prices received by country shippers from seedsmen at the large distributing points. The seedsmen of the country have been listed, and information has been secured regarding points where surplus stocks are available. Both buyers and sellers have made use, through correspondence, of the information and assistance of the bureau in the distribution of such stocks.

Information has been obtained relative to seed stocks, movement, and prices, and has been furnished to the Seed Stocks Committee of the Department of Agriculture upon which it could base any action contemplated by the committee in the purchase and sale of seeds under the food-production act.

Special attention has been given to the condition of seed as marketed by farmers, the resulting customs of assessing dockage, and abuses which have been practiced in assessing such dockage. In some instances the dockage assessed has brought the country buyers higher prices than that paid the producer for the seed sold. Studies have been undertaken of the relation of existing grades in clover and timothy seed to prices paid, and to laboratory tests for purity and germination; the results of lack of uniformity in grades used in different markets and by different seedsmen throughout the country; and the advantage of the keeping of records of the source and disposition of stocks by seedsmen and the advisability of devising standard records for distribution among the trade. Study also has been undertaken as to the probable effect of a change in the prevailing method of sale of seed from the bushel-measure standard of the Eastern States to the hundredweight (or centnal) system of the North and Northwest.

The results of the investigations and studies relating to grain, hay, and seeds are being utilized as a basis for a market reporting service, the inauguration of which will be described under Service.

FOREIGN MARKETS INVESTIGATION.

The foreign markets investigations, under the direction of Mr. Clarence W. Moomaw, are planned primarily for normal conditions. However, considerable advance has been made in preparing for the extension of these investigations at the conclusion of the war, and some active work of present value is under way.

As reported last year, a representative of the bureau was sent to Europe in June, 1916, where he made preliminary studies for several months in the United Kingdom, France, Italy, Switzerland, and Spain, in cooperation with American diplomatic, consular, and commercial officers in Europe. The studies included the prevailing market conditions, tradesmen's organizations in grain, cotton, and other commodities; warehouses, wharf facilities, and central and retail markets for meats and other perishable products. The marketing of American grain, cotton, fruit, and nuts received special attention.

Throughout the year, by arrangement with the State Department, reports of Italian lemon shipments to the United States have been received by cable and disseminated in the United States.

Early in June a representative of the bureau was sent to investigate the fresh, dried, and canned fruit markets in China, Japan, Eastern Siberia, the Philippines, Australia, and New Zealand. The investigation is being made in cooperation with the Consular Service of the Department of State and the Bureau of Foreign and Domestic Commerce of the United States Department of Commerce. The limited supply of suitable tonnage for this trade has been a discouraging factor. Through the efforts of the representatives of the bureau, the Canadian Pacific Line, foreseeing a reflected benefit in the Canadian fruit industry, agreed to cooperate with the bureau by making available to the shippers of the Pacific Northwest sufficient tonnage for their requirements during the coming season.

FRUIT TRANSPORTATION AND STORAGE.

Pending the transfer of the work on fruit transportation and storage, under Mr. H. J. Ramsey, to the Bureau of Markets, the work has been conducted in cooperation with the Bureau of Plant Industry. The work for the fiscal year 1917 will be reported by that bureau.

MISCELLANEOUS PUBLICATIONS.

The following publications have been issued in connection with the work on marketing and distributing farm products: Service and Regulatory Announcements No. 21, Suggestions for an Act to Establish a Division of Marketing in Any State (in cooperation with the Office of the Solicitor); Markets Document 5, The Marketing of Canning Club Products; and Markets Document 6, Distribution and Utilization of the Garden Surplus.

FOOD SUPPLY INVESTIGATIONS.

In accordance with an item contained in the last agricultural appropriation act, plans have been formulated for an investigation, in cooperation with the Federal Trade Commission, of the cost of production and of the marketing, manufacture, and distribution of live stock and meats and the principal grains entering into food. Data concerning the cost of production are being collected from records of the department, the State experiment stations, and producers in various parts of the country, and representatives are in the field

gathering information concerning marketing and distribution. This information will show the relation between profits and services rendered and will also form a basis for constructive suggestions concerning the handling of these products.

These investigations are under the direction of Mr. C. S. Cole.

COOPERATION WITH STATES IN MARKETING WORK.

Cooperation with States in marketing work was authorized and provided for by an item in the agricultural appropriation act on the 11th of August, 1916. Mr. J. C. Skinner is acting in charge of the work. During this first year it has been necessary, first, to secure the proper contact in the several States; second, to make the selection of representatives to undertake the work; and third, to enter into cooperative agreements outlining in detail the work to be undertaken. Therefore the work performed in cooperation with the several States began at different dates, ranging from August 11, 1916, to May 4, 1917.

In some States the cooperation is conducted in connection with State market bureaus, in others with the extension divisions of the agricultural colleges or with the commissioners of agriculture or other State agencies. The purpose of the cooperation with States in marketing work is to assist the States in acquiring and diffusing useful information regarding the marketing of farm products. Nineteen States have been thus assisted.

The plan has been to have the field agents in marketing in the several States give the major portion of their time to specific problems, in order that they might be able to render concrete assistance. Therefore, it has been necessary for each man to devote considerable time to observing the marketing problems of the State and to learning the local conditions relating to the work. In some States the work has not had time to develop beyond this primary stage. In others investigations have been started, and in still others investigations have been completed and results made available to the people of the State. While, as a whole, the work is in an elementary state, enough has been accomplished to indicate its value to the people and to show that concrete results may be expected as the work is developed. During the year the following specific help has been rendered:

Arizona.—A complete survey of Maricopa County is being made in order to assist producers in the proper marketing of the county's products.

Arkansas.—In connection with the States Relations Service assistance has been rendered in the marketing of early Irish potatoes, wheat, and radishes. Seventeen ice plants have been instructed in regard to the proper methods of curing hogs. A book of instructions has been issued and distributed to the cold-storage plants in the State.

Colorado.—Investigations in regard to the marketing of poultry products, dairy products, honey, and beans are near completion, and assistance has been rendered during the course of the investigations.

Georgia.—Investigations in the marketing of sweet potatoes have been conducted, and assistance rendered to the growers in regard to the grading and storage of their products.

Kentucky.—Thirteen egg circles have been formed and 100,000 eggs for hatching have been placed in various counties of the State with a view to improving conditions surrounding the production and marketing of poultry products. Four existing strawberry associations have received assistance and one was organized. One cantaloupe growers' association and one live-stock association have been organized and assistance has been rendered to the wool producers. Assistance has also been rendered during investigations in the marketing of hemp.

Louisiana.—Assistance has been given to producers of live stock by means of demonstrations, which have had marked results. Several potato-selling associations, some sweet potato associations, two community associations for the cooperative selling of live stock, and one cane sirup association have been organized. Advice and assistance have been rendered the wool growers and the sellers of ground oats and various truck crops, and the dairy producers have been helped with their problems.

Michigan.—Seven new cooperative organizations have been formed and 10 existing associations have been reorganized to conform with plans suggested by this bureau. Eight shipping associations and four grain elevators have been assisted in regard to their methods of keeping accounts.

Minnesota.—In 79 cases the methods of using accounts for grain elevators were demonstrated, and the system of accounting previously devised by the market business practice project of the bureau was installed in 43 cases. The method of operating the uniform accounting system for live-stock associations was demonstrated in 13 cases and installed in 5.

Montana.—Assistance to grain producers has been given in the form of demonstration. This demonstration has consisted of the installation of better business methods in 18 elevators in Montana.

Nebraska.—Investigations have been completed regarding car-door peddling of fruit and vegetables. The results are being considered for publication.

North Dakota.—Two publications have been issued as bulletins of the extension division in North Dakota, namely: (1) Organizing Cooperative Associations, and (2) Comments from an Agricultural Field Trip Across North Dakota. Other bulletins are in course of preparation as a result of investigations on farmers' elevators and the marketing of potatoes. A number of local potato growers' associations have been organized and assisted.

Oklahoma.—Assistance was given to 10 organized communities in the elaboration of proposed grades for various farm products and in the demonstration of the usefulness of grading.

Oregon.—Assistance has been given in the establishment of two cooperative cheese factories. Various surveys in regard to cooperative organizations and dairy marketing have been made as a basis for further assistance.

South Carolina.—A cooperative cantaloupe association has been formed and an asparagus association received assistance and instruction as to the proper method of grading their product. Cabbage and potato growers have been instructed in the proper methods of preparing their crops for market.

Tennessee.—Five cooperative associations have been formed and 15 demonstrations given with a view to improving the proper methods of marketing various farm products.

Utah.—Preliminary study of marketing conditions has been made in the State as a basis for specific investigations.

Vermont.—The dairy industry has been assisted in improving the quality, pack, and shipping methods of dairy products. Producers of eggs and poultry have received assistance in finding proper marketing fields. Five cooperative creamery associations, one cooperative dairy association, and one active cattle producers' association have been organized.

Virginia.—Investigations have been made in the marketing of apples and the marketing of peanuts, the results of which will be given to the public. A preliminary study of wheat marketing in the State has been made. Assistance has been rendered to cooperative marketing associations in grading and packing products for market.

Washington.—An investigation of the handling of grain has been begun. A State marketing bureau has been formed recently and the former State agent in marketing of this bureau was chosen as its director.

RURAL ORGANIZATION INVESTIGATIONS.

The rural organization investigations are divided into two groups, both being under the direction of Mr. C. W. Thompson.

RURAL CREDIT, INSURANCE, AND COMMUNICATION.

RURAL CREDIT.

A comparative digest of existing State laws relating to credit unions has been made and a model State law has been drafted, in cooperation with the Office of the Solicitor, providing for the incorporation and supervision of cooperative credit associations or credit unions.

Further information has been secured with regard to the cooperative credit associations already organized among farmers. Especial attention has been given to a study of the plan in operation in North Carolina, where the farmers receive direct encouragement and assistance in the organization of credit unions from a State official, and to the formation of similar associations among Jewish farmers, under the patronage of a national Jewish organization. This study has been made particularly with a view to determining what methods might best be adopted for the promotion of this type of cooperation among farmers in localities where cooperative credit associations have not yet been formed.

The investigation reported last year to determine the extent to which farmers in the Southern States obtain credit from merchants, either under the advancing system or otherwise, has been completed. The returns show, among other things, a close cause and effect relation between the advancing system and one-crop cotton farming. In some sections where cotton is the dominant crop, 80 per cent of the farmers are reported as operating under the advancing system, as compared with 20 to 25 per cent in other sections where little or no

cotton is raised, the average for the 10 cotton States being 60 per cent. The figures also indicate that more than 40 per cent of the general merchants' sales to farmers are for cash, and that of the credit sales, 45 per cent are on open account (without security), 43 per cent on crop lien, and 12 per cent secured in other ways.

A study of the live-stock loan business has been begun. Information has been gathered from officers of banks in the financial centers of the East, and from officers of banks and cattle-loan companies and members of commission firms in the large live stock markets of the Central West, concerning the volume and the making, safeguarding, and rediscounting of cattle loans, and the rates charged.

At the request of the Federal Farm Loan Board, with which this work is carefully coordinated, field assistance has been given in their educational campaign and a series of amortization tables has been prepared. Farmers' Bulletin 792, How the Federal Farm Loan Act Benefits the Farmer, has been issued.

A preliminary study has been made with regard to the Torrens system of land-title registration, covering both the laws in force in certain of the States and the subject of land-title registration laws in general.

INSURANCE.

Field studies of various types of farmers' mutual insurance companies have been continued and the tabulation of the information received through questionnaires has been completed. An article entitled "Farmers' Mutual Fire Insurance" was published in the Yearbook for 1916 and issued as Yearbook Separate 697, and Department Bulletin 530, The Organization and Management of a Farmers' Mutual Fire Insurance Company, has been issued. A digest has been made of the State laws relating to farmers' mutual insurance.

COMMUNICATION.

Further study has been made of rural telephone companies and telephone systems in Ohio, Indiana, Michigan, the New England States, and most of the Southern States. A great deal of information regarding the various types of organization and the practices of such companies has been obtained.

RURAL SOCIAL AND EDUCATIONAL ACTIVITIES.

A report of the social and economic survey of Albemarle County, Va., including a number of charts and diagrams, has been prepared. Active field assistance has been given in making a community survey of Christiansburg, Va., and the neighboring farming country. The results of this survey have been tabulated. A preliminary study has been made of the economic value of women's rural organizations in direct marketing.

A list of State and county fairs and a partial list of community fairs have been made, copies of State laws relating to fairs have been collected, and some field observations have been made preliminary to a general study of fairs. A manuscript has been prepared entitled "The Community Fair" and will be issued as Farmers' Bulletin 870.

A study has been made of the purpose, cost, financing, maintenance, management, and activities of 60 rural community center buildings and of the organizations responsible for them. General information concerning about 35 more such buildings and organizations has also been secured.

Suggestive programs for the meetings of community organizations have been prepared and furnished to associations in a number of States. Three programs on rural-credit subjects were prepared for use in 1,200 farmers' clubs in Minnesota; six programs were prepared and furnished to about 1,200 school and civic leagues in Virginia, under a cooperative agreement with the division of extension of the Virginia Polytechnic Institute; and programs were furnished to the Agricultural and Mechanical College of Texas, as well as to individual clubs making application from Alabama, Tennessee and other States.

INVESTIGATION AND DETERMINATION OF GRAIN STANDARDS.

DETERMINATION OF STANDARDS.

Federal standards for shelled corn were promulgated September 1, 1916, and became effective on December 1, 1916. Standards for wheat were promulgated March 31, 1917, to take effect, for the winter wheats, on July 1, 1917, and, for the spring wheats, on August 1, 1917. Close observation is being made of the effect of the application of these grades, for the purpose of determining whether or not alteration or modification may be necessary. Data necessary to the establishment of Federal standards for oats have been assembled and compiled, with a view to an early promulgation of standards for this grain. Investigations relating to standards for the other grains are being pushed as vigorously as possible. Dr. J. W. T. Duvel directs this work.

CONTRIBUTING INVESTIGATIONS.

In connection with the establishment of factors which will govern the standards for oats, an exhaustive study is being made of the problems relating to the sulphur bleaching of oats on a commercial scale. In connection with the establishment of grades, a careful study has been made of dockage and its effect on the grades. A detailed study is now under way to determine the best method for combating smut spores in wheat in the Pacific Northwest. Data have been collected showing the total storage and milling capacity at various points, the total for any one State, and the total for the United States. Milling and baking tests on the various types of wheat and flour have been conducted to determine the adaptability of the different varieties for bread making. Experiments have been conducted to determine the best and most inexpensive methods of handling grain in the Northwest.

Representative samples have been secured and are now being examined to determine the amount of admixtures of other wheats and foreign material in seed wheat.

A revision of the method for determining acidity in corn has been published as Circular 68 of the Office of the Secretary, which makes the method applicable to commercial conditions.

Investigations relating to the harvesting, handling, storing, and grading of rice have been continued. Special attention has been given to the factors which are considered in the commercial grading of rough and milled rice, with a view to establishing definite standard grades therefor. An experiment indicated that rice cured in properly constructed shocks is worth 12 cents per barrel, or \$1.60 per acre, more than that secured in poorly made shocks. Experiments showed also that during a very dry harvesting season the loss in weight from natural shrinkage of rough rice in storage, during the three months after thrashing, was approximately one-half of 1 per cent.

The following Department Bulletins have been issued jointly with the Bureau of Plant Industry, summarizing the results of certain phases of investigational work: No. 374, The Intrinsic Values of Grain, Cottonseed, Flour, and Similar Products, Based on the Dry-matter Content; No. 455, The Drying for Milling Purposes of Damp and Garlicky Wheat; No. 472, Improved Apparatus for Determining the Test Weight of Grain, with a Standard Method of Making the Test; No. 473, The Origin, Characteristics, and Quality of Hump-back Wheat; No. 516, Table for Converting Weights of Mechanical Separations into Percentages of the Sample Analyzed; No. 522, Characteristics and Quality of Montana-grown Wheat; and No. 557, A Comparison of Several Classes of American Wheats and a Consideration of Some Factors Influencing Quality.

INVESTIGATION AND DEMONSTRATION OF COTTON STANDARDS AND COTTON TESTING.

The investigation and demonstration of the official cotton standards of the United States and the work in cotton testing have continued under the direction of Mr. Fred Taylor.

INVESTIGATION AND DEMONSTRATION OF COTTON STANDARDS.

STUDIES TOWARD FURTHER STANDARDIZATION.

The studies toward further standardization of cotton, including length of fiber and the study of Sea Island cotton, have been continued along the same lines as reported last year. Thousands of additional samples have been collected in the different markets, studied, and classified. The Sea Island samples were classified on the basis of a tentative set of standards prepared from samples collected during the season of 1915-16 and the results in relation to the prices obtained by the growers have been tabulated. This work, which has now covered two seasons, shows that the discrepancies obtaining in the prices paid for the same qualities of Sea Island cotton are even wider than those found in the primary short staple markets. Owing to the advent of the boll weevil in the Sea Island district a number of varieties are now being planted and experimented with, and it has not been found feasible to promulgate standards for this important crop until conditions are more settled.

Three thousand three hundred and seventy-five bales of the Arizona-Egyptian cotton, 240 of which were of the Pima variety, bred by Mr. T. H. Kearney, of the Bureau of Plant Industry, in connection with the work of the Southwestern Cotton Culture Commit-

tee, were classified on the basis of the tentative standards for this cotton prepared during the season of 1914-15. Apparently these tentative standards thus far have proved satisfactory as a basis for the handling of this class of cotton.

Work also was continued in cooperation with the Imperial Valley Long Staple Cotton Growers' Association in the classifying of their cotton. Owing to the extreme brightness of this cotton as compared with cotton produced in other sections of the country it was found necessary to assist the association in the preparation of types representing the different qualities of cotton handled by the association as a basis for their transactions with the buyers.

COMPARISON OF LIVERPOOL COTTON STANDARDS WITH THE OFFICIAL COTTON STANDARDS OF THE UNITED STATES.

A complete set of Liverpool standards, effective September 1, 1916, covering American, Texas, and Gulf cotton, recently received by the Department of Agriculture, was carefully compared with the official cotton standards. The Liverpool standards as a whole are brighter in color and carry more leaf. Also, they allow less color in the grades below Middling.

ADOPTION OF THE OFFICIAL STANDARDS BY THE ROTTERDAM COTTON EXCHANGE.

To promote the use of a universal standard of grade for American cotton, sets of the official cotton standards of the United States have been forwarded to the principal cotton markets of the world. This has resulted in the official adoption of these standards by the Rotterdam Cotton Exchange, and they are hereafter to be used as the basis of settlement of all contracts involving American cotton dealt in on that market.

DEMONSTRATIONS OF STANDARDS.

Demonstrations of the use of the standards, with a view to showing organized communities the advantages of classing cotton before sale, were conducted in 22 counties in North Carolina; at Orangeburg, Easley, St. Matthews, and Sumter, S. C.; Dublin and Jefferson, Ga.; Little Rock, Scott, Camden, Forest City, and each of the four district agricultural schools in Arkansas; Altus and Blair, Okla.; Sweetwater, Waxahachie, Bryan, and Tyler, Tex. Representatives of the bureau were stationed in these places, who showed the farmers how to class their cotton, and who kept records of sales, prices, and other pertinent facts. One hundred and twenty-five sets of copies of the standards also were furnished to demonstration agents of the States Relations Service.

COTTON TESTING.

MANUFACTURING TESTS ON THE OFFICIAL COTTON STANDARDS.

Tests that were in progress last year at commercial mills at Fall River, Mass., as well as the tests that were in progress at the New Bedford Textile School, New Bedford, Mass., and at the North Carolina State College of Agriculture and Engineering, West

Raleigh, N. C., have been completed. These tests were made on cotton of the 1914 crop, representing five different grades of the Official Cotton Standards.

The following are the averages of the total percentages of visible and invisible waste as found in the textile school and mill tests combined: Middling Fair, 6.30; Good Middling, 7.05; Middling, 9.25; Low Middling, 10.77; and Good Ordinary, 14.41.

The following are the averages of the tensile strength in pounds per skein (120 yards) of 22's yarn, 4.75 twist factor, as found in the textile school and mill tests combined: Middling Fair, 77.2; Good Middling, 76.2; Middling, 74.3; Low Middling, 69.8; Good Ordinary, 69.5.

The bleaching tests showed that when the goods made from each grade were bleached under identical conditions Middling Fair and Good Middling were practically the same in color after bleaching. The goods made from Middling and below did not produce quite as pure a white, but for commercial purposes gave satisfactory results.

A comparison of results of these tests with the results obtained in a test made in 1913 on cotton representing the old permissive cotton grades shows that the changes made in the revision of the old permissive grades did not increase the percentages of waste in the corresponding grades, but involved principally the factor of color in the lower grades.

COMPARATIVE SPINNING TESTS OF THE PIMA AND YUMA VARIETIES OF THE
ARIZONA-EGYPTIAN COTTON.

Spinning tests were conducted at New Bedford Textile School on cotton representing Extra, Choice, and Standard grades of the Pima and Yuma varieties of the Arizona-Egyptian cotton. The staple of the Pima was one-eighth inch longer than that of the Yuma.

In brief, the following results were observed: (1) The Yuma cotton was from 2 to 3 per cent less wasty than the Pima when run under identical mechanical conditions; (2) the Yuma cotton produced 23's yarn equal in strength to the Pima from the grades of Choice and Standard, while the Pima produced 23's yarn practically 2 pounds per skein stronger from the Extra grade; and (3) Pima cotton produced 100's yarn approximately 2 pounds per skein stronger than the Yuma.

SPINNING TEST ON COTTON REPRESENTING A NUMBER OF THE PRINCIPAL VARIETIES
OF UPLAND COTTON.

Spinning tests are now in progress at the North Carolina State College of Agriculture and Engineering on the following varieties of Upland cotton: Triumph, Lone Star, Acala, Half-and-Half, Rowden, and Trice. One of the purposes of making these tests was the comparison of the manufacturing qualities of these well-known Upland varieties of cotton with the Half-and-Half variety, which has been introduced in various sections of the cotton belt. Forty-one tests are in progress.

An attempt was made to spin the following numbers of yarns from the cotton representing each variety—namely, 20's, 22's, 24's, 28's, 36's, and 40's. Several different twist constants were used on

the 28's. It was not found practicable to make numbers 36's and 40's out of the Half-and-Half cotton, while all of the other varieties except two bales of the Rowden were spun without difficulty into 36's and 40's. In most cases it was found impracticable to produce successfully yarns finer in numbers than 24's from the Half-and-Half variety.

COMPARATIVE TEST OF THE MEADE VARIETY WITH THE SEA ISLAND COTTON GROWN UNDER THE SAME CONDITIONS.

The Meade variety, which was developed by Mr. Rowland M. Meade, of the Bureau of Plant Industry, is a long-staple cotton very similar to the Sea Island cotton in character, but matures several weeks earlier. This variety is now being tested in the textile department of the North Carolina State College together with Sea Island cotton. The Meade variety is about one-eighth inch shorter than the Sea Island cotton.

SPINNING TEST TO DETERMINE THE EFFECT OF VARIOUS METHODS OF COMPRESSION.

Seed cotton of different staples ranging from seven-eighths inch to $1\frac{1}{4}$ inches was secured and ginned under the supervision of employees of the Bureau of Markets for the purpose of making spinning tests to determine the damage, if any, caused by compressing cotton to greater densities than usual by various methods. The cotton representing each staple was divided into equal parts and ginned, after which the lint was baled under different conditions. The following kinds of bales were produced: Gin compressed, flat bale or uncompressed, compressed or railroad compressed, high density compressed, and round bale compressed. The cotton has been shipped to a commercial cotton mill in North Carolina, where spinning tests to determine the results of various methods of compression are in progress.

SERVICE.

Probably the most directly useful and concrete work of the Bureau of Markets is its market news service on various commodities. This service, and the resulting series of daily and other periodical reports issued by telegraph, telephone, and mail, are the outgrowth of investigations by the department. In the development of these services the department has had the advice and services of men of commercial experience whose aid has been of great value in shaping the work.

FRUITS AND VEGETABLES.

Four series of reports are issued relating to fruits and vegetables: The Daily Carlot Shipments and Jobbing Price Reports of Fruits and Vegetables; the Weekly Summaries of Carlot Shipments; the Weekly Market Reviews; and the Daily Market Reports on Locally-Grown Truck Products. The first three series are under the direction of Mr. Wells A. Sherman. The last has been developed by Mr. G. V. Branch in cooperation with the producers or consumers of the localities affected.

DAILY CARLOT SHIPMENTS AND JOBBING PRICE REPORTS OF FRUITS AND VEGETABLES.

In the calendar year 1916 nine crops were reported: Strawberries, tomatoes, cantaloupes, peaches, onions, watermelons, grapes, potatoes, and apples. Eleven permanent branch offices were maintained in the following cities: Philadelphia, New York, Boston, Buffalo, Pittsburgh, Cincinnati, Chicago, Minneapolis, Denver, Kansas City, and St. Louis. Baltimore was temporarily discontinued as a permanent office. Arrangements were made to secure market reports from the trade in 12 southern markets during the movement of crops from the North, in addition to similar reports from eight northern cities, making 20 markets from which temporary reports were secured. Market news bulletins were distributed in 40 producing sections, an increase of 33 sections over the previous calendar year. Approximately 3,000,000 bulletins were distributed to over 52,000 individuals.

During the calendar year 1917 reports have been distributed on 11 crops to date, and additional commodities may be covered during the winter months. Baltimore was opened as a permanent market station, making 12 permanent branch offices.

One of the most radical improvements made in the service this year was the installation of a leased wire connecting all of the permanent branch offices with the exception of Denver. This leased wire has done much to expedite the service, and has enabled the Bureau to include much more detailed information in its reports. From May 8 to June 8, 1917, the messages which were transmitted over the leased wire, if charged for, would have cost \$10,103.70. The cost for the complete leased wire service a month was \$3,350, making a net saving for one month of \$6,753.70.

The results of this service have been apparently as satisfactory as during previous years to growers, growers' organizations, shippers, commission merchants, and consumers.

WEEKLY SUMMARIES OF CARLOT SHIPMENTS.

The Weekly Summary of Carlot Shipments, which was begun in May, 1916, summarizes each week the daily shipment reports, giving comparative totals for the corresponding week the previous year, for this season to date, for last season to the corresponding date, and other information. The mailing list for the summary at present contains about 1,100 names, and is growing rapidly. This series is of special interest to statistical students and to newspapers.

Station agents on approximately 225,000 miles of railroad out of a total of 260,000 miles in the United States are now reporting daily by mail the shipments of perishable fruits and vegetables made from their stations. Approximately 10,000 station agents, representing some 500 transportation lines, have cooperated in this work. It is estimated that approximately 750,000 carloads of fruits and vegetables have been reported to this bureau from April 1, 1916, to July 1, 1917, and that these reports represent from 75 to 80 per cent of the total movement of fruits and vegetables in this country. About 80 commodities are included. It is planned to issue semiweekly or weekly reports giving the total shipments of these commodities as a supplement to the telegraphic shipment reports.

WEEKLY MARKET REVIEWS.

In April, 1917, the Weekly Market Review series was begun. Each review analyzes the daily telegraphic market reports of the week, showing the trend of the market and the changes which are taking place. A distinct demand has been shown for a similar report covering retail prices which can be used by the newspapers as a basis for a "consumer's service." The review series proves to be of especial use to newspapers and trade papers and it is through them largely that the contents reach the people.

DAILY MARKET REPORTS ON LOCALLY GROWN TRUCK PRODUCTS.

In cooperation with the Providence (R. I.) Market Gardeners' Association, experimental work was started May 1, 1917, under Mr. G. V. Branch, on the large wholesale farmers' market owned by that association. The purposes, briefly stated, were to record and tabulate as early in the morning as possible after the growers arrived on the market the total quantity of each different product offered for sale; to post the results at various places on the market in order that they might serve as a guide to both producers and buyers; to secure accurate and complete price data, and with all of this information in hand to prepare for the local press a popularly written but absolutely reliable daily market report on locally grown fruits and vegetables.

The results of this work have been far beyond expectation. The posting at an early hour of the total quantities of the important products has helped buyers and sellers greatly in agreeing on fair prices based on an accurate knowledge of the day's supplies. The daily press report has given special advice to housewives regarding products that were being received in large quantities and were low priced, in addition to publishing a list of all the fruits and vegetables offered, the quantities of each, and the prices at which they were sold at wholesale to various retailers. This information has greatly stimulated the demand on the part of consumers, tended to lower retail prices, and thus allowed a freer movement. Although retailers generally have sold at lower prices, their net profits often have been increased, because of quick turnovers and the elimination of waste. The heavy demand has helped to stabilize the prices which the growers receive and in certain cases has prevented disastrous gluts.

Because of the very evident improvement in local marketing conditions at Providence, it was decided to extend this service as an emergency movement to a number of other cities having centralized wholesale farmers' markets. Cooperative relationships were entered into with local truck growers' organizations or with the municipal government at Boston and Springfield, Mass., Albany, N. Y., Cleveland, Ohio, Grand Rapids, Mich., St. Paul, Minn., and Denver, Colo. The reporting service in these cities has been installed so recently that it is not practicable to judge the results accurately as yet. However, all reports received to date have been most satisfactory, and it is felt that much can be expected from this new line of endeavor when it is properly developed.

LIVE STOCK AND MEATS.

Three series of reports are now issued on live stock and meats, under the direction of Mr. L. D. Hall. All of them have been developed since the last annual report. Plans are under way for other series. The first attention was given to collecting and distributing information which appeared to be most lacking and in greatest demand by the entire live stock and meat trade, namely, the current supply and prices of dressed meats and meat products, and the demand and other marketing conditions affecting their distribution. Reports on two principal features of this class of information were undertaken: First, the stocks of frozen and cured meats on hand in wholesale packing establishments and public cold storages throughout the United States, described later; and, second, market conditions, including daily supplies and prices of fresh meats at the principal consuming centers.

A preliminary study of the meat trade was made in Boston, New York City, and Philadelphia with the object of establishing contacts with the wholesale, jobbing, and retail meat trade and acquiring information relative to market facilities, demands, grades, prices, conditions, and marketing methods prevailing at those points. Before formulating final plans for the work, prominent officials and individuals representing various branches of the live stock and meat industry were consulted as to the classes of information desired and the most effective means and methods whereby to collect and distribute such information.

DAILY REPORTS ON MEAT TRADE CONDITIONS.

Permanent local offices for this work have been established in Boston, New York, Philadelphia, Washington, Chicago, Omaha, Kansas City, Portland (Oreg.), and Fort Worth (Tex.). Representatives at the eastern cities gather daily from wholesale meat dealers and from the jobbers and retailers who buy at the wholesale markets information relative to meat trade conditions, including demand, supplies, and wholesale prices, and transmit reports by direct leased wire to the office in Washington, where they are relayed by leased and commercial wires to each of the western branch offices. The first of these reports was issued on February 19, 1917, and by September 15, 1917, approximately 1,700 copies of these reports were being distributed daily from each local office to members of the trade, trade papers, and other interested parties. All of the live stock market papers at points where our bulletins are issued publish them either entire or in part and make frequent references to them in their market columns. Indications are that these reports have tended materially to stabilize market conditions, have furnished a more intelligible basis for live stock market quotations, and have enabled the public to follow the relative margins between prices of live stock and meat.

Various terms now in use by the trade are not accepted uniformly as having the same meaning in all markets. In connection with the publication of daily reports on meat trade conditions, steps have been taken toward the establishment of more uniform standards for the classes and grades of meats and a more logical nomenclature for

these grades. Tentative classifications of western dressed fresh beef, lamb, and mutton have been adopted and used in the daily reports on wholesale prices of these classes of meat.

DAILY REPORTS ON LIVE STOCK LOADINGS.

Through the transportation project of this bureau, arrangements were made with all the railroads west of the Allegheny Mountains under which their division superintendents telegraph daily to the Washington office the numbers of single and double deck cars of each class of live stock loaded during the preceding 24 hours, with destinations. This service was inaugurated January 2, 1917. From 300 to 325 telegrams showing loadings are received each night. The information is tabulated by a night force and is released by telegraph to the branch stations at 7 o'clock each morning, and is also released in the form of daily bulletins, including Sunday.

In addition to the daily loadings of live stock, arrangements were made with the railroads to furnish statistics relative to the total loadings of each class of live stock in 1916 at each station on their lines. A large number of the railroads have furnished this information for the year 1915, and these data are being compiled.

MONTHLY REPORTS OF STOCK YARDS RECEIPTS.

Officials of 58 stock yards companies transmit monthly reports to this bureau showing the receipts and shipments of live stock at their yards. In addition, officials of 37 of these yards report monthly the number of stockers and feeders shipped or driven out to feeding districts. During the past two months these reports have been tabulated and a report on receipts at stock yards has been issued by the bureau shortly after the first of each month. Thorough investigation has indicated that this information will be of material value in determining the actual and relative movements, supply, and location of marketable live stock in the country.

WOOL.

For the purpose of ascertaining and making known the available supply of wool, schedules are being sent, under the direction of Mr. L. D. Hall, to approximately 2,200 wool dealers and manufacturers, or to all whose names can be obtained.

QUARTERLY REPORTS ON THE SUPPLY OF WOOL.

The first quarterly report on the supply of wool on hand was issued as of June 30, 1917. This report covered stocks of wool, tops, and noils on hand on that date, segregated into the various commercial classes and grades. It is believed that this report constituted the most complete inventory of wool supplies in the United States ever compiled, and it is planned to make it the first of a permanent series of reports. Hereafter these reports will give a comparison with previous supplies of all classes of wool, tops, and noils, both foreign and domestic, held by dealers and manufacturers.

HONEY.

As a part of concerted effort in other parts of the Department of Agriculture, to increase the production and use of honey, this bureau undertook to issue market reports on this commodity, under the direction of Mr. Wells A. Sherman. Dr. E. F. Phillips, of the Bureau of Entomology, assisted in organizing the work.

BIWEEKLY MARKET REPORTS ON HONEY.

These reports show the arrivals of honey on the market at Chicago, Cincinnati, Denver, Kansas City, Minneapolis, New York, Philadelphia, and St. Louis, as reported by the railroads during the previous two weeks, as well as the range of jobbing prices for the different varieties and grades for the same period. The first report was issued on June 15, 1917.

GRAIN, SEED, AND HAY.

Plans for the inauguration of a market reporting service on grain, seed, and hay are being perfected under the leadership of Mr. George Livingston, Mr. K. B. Seeds, and Mr. W. A. Wheeler. Voluntary correspondents have been secured and arrangements made for the submission to the Washington office and to offices to be maintained in the field of reports regarding prices, demands, receipts, shipments, and holdings of grain, hay, and seed at different markets throughout the country. These weekly or biweekly reports will be assembled and compiled at the central offices and made available by telegraph and by mail to all interested persons. It is planned to keep the trade constantly advised as to the markets at which they can advantageously buy or dispose of stocks in the hope of preventing the great losses heretofore occasioned by producers and buyers through lack of information regarding the current conditions of the various markets.

BIWEEKLY REPORTS ON GRAIN AND HAY.

The first reports were issued August 11, 1917, on wheat, corn, oats, and hay for the States of Virginia, West Virginia, North Carolina, South Carolina, Maryland, and Delaware, and similar reports have been issued every other Saturday since that time. They show the stocks on hand, the prices prevailing, and the probable receipts and shipments in that territory. Special reports on other grains and market conditions usually accompany these. The work of organizing six other divisions is now well under way. The first reports probably will be issued for the North Atlantic, Southeastern and Southwestern Divisions about November 15, and for the East Central, West Central, and North Central Divisions about December 15.

MONTHLY REPORTS ON SEEDS.

A publication under the title "Seed Reporter" is to be issued by the seed-reporting service. It will incorporate reports of stocks of seed on hand, movement, trend of prices, qualities, probable demand, and such other information relative to seeds that should be made

immediately available to the seed trade and thus assist in an economic and efficient distribution of seeds.

It will be mailed to seed growers, shippers, dealers, county agents, and others who can utilize this information to advantage.

COLD STORAGE HOLDINGS.

Cold storage holdings of apples only were issued by this bureau during the winters of 1914 and 1915. At the beginning of the fiscal year 1917 Mr. I. C. Franklin was added to the force engaged in storage work. In cooperation with the various investigative staffs involved, these activities have been developed rapidly.

MONTHLY REPORTS SHOWING COLD STORAGE HOLDINGS.

Monthly reports on cold storage holdings are now issued on 18 commodities as follows: Boxed apples, barreled apples, storage eggs, frozen eggs, cheese, butter, frozen beef, cured beef, frozen pork, dry salt pork, sweet pickled pork, lard, lamb and mutton, broilers, roasters, fowls, turkeys, and miscellaneous poultry.

Reports of the cold-storage holdings of butter and eggs were begun August 1, 1916; cheese, September 1, 1916; and lard and meats, December 1, 1916. Meats are reported by the following six classes: Frozen beef, cured beef, frozen pork, dry-salt pork, sweet-pickled pork, and frozen lamb and mutton. Reports of the holdings of frozen eggs in cans and of frozen poultry were begun May 1, 1917. Poultry is reported by the following five classes: Broilers, roasters, fowls, turkeys, and miscellaneous poultry. All reports are issued monthly, with the exception of the butter and egg reports during the season when the greatest quantity of these two commodities is moving into storage. The reports are based on holdings as reported to the bureau by all the important cold-storage houses throughout the country, including the holdings of the large meat packers.

The number of houses reporting on a given commodity varies to some extent from month to month, but there has been from the beginning a steady increase in the total number of houses reporting.

At the present time 1,276 firms are submitting voluntary reports showing their holdings of these commodities. Of these, 764 may be classified as general cold-storage houses and 512 as packing houses. The mailing list of persons to whom these reports are sent numbers about 12,000. Approximately 129,000 individual reports are sent out each month. The reports have been well received by the press, the public, and the cold-storage trade. They constitute the first comprehensive public information of this kind in this country.

REGULATORY.

The Bureau of Markets is now charged with the administration and enforcement of four Federal statutes—the United States cotton futures act, the United States grain standards act, the United States warehouse act, and the United States standard container act. The last three of these laws were enacted during the fiscal year 1917, and the requisite provision and machinery for their administration have been developed during this period. In every case previous studies

and investigations conducted in accordance with the approved program of the bureau have supplied valuable results and material for use in this regulatory work.

UNITED STATES COTTON FUTURES ACT.

The cotton futures act was reenacted in a revised form on August 11, 1916. Rules and regulations under the revised act have been issued as Circular 70 of the Office of the Secretary, and Service and Regulatory Announcements Nos. 10 and 16 were issued to inform the trade and others interested of the changes made in the act, of the repromulgation of the Official Cotton Standards of the United States for both white and colored cotton under the new act, and of other pertinent matters. Mr. D. S. Murph has been designated by the chief of the bureau to supervise the general administration of this and of the warehouse act.

INVESTIGATION OF FUTURE AND SPOT MARKETS.

The work with future and spot markets has followed as closely as possible the steps of the previous year, under the direction of Mr. G. R. Argo, who has also been in charge of the disputes and appeals.

The future exchanges at New York and New Orleans have made the necessary revisions in their rules to conform with the reenacted cotton futures law, effective September 1, 1916.

All sales of spot cotton made in New Orleans have been examined by a representative of the bureau, who has kept the bureau advised of general conditions regarding cotton marketing in New Orleans. Relations calculated to produce desirable cooperation have existed throughout the year between the Department of Agriculture and the future exchanges.

A chart showing the fluctuations on the future exchanges has been kept and with the exception of about three months, when a severe break in the future market occurred, the parity between spots and futures has been well maintained. It is believed that had not unusual and abnormal conditions existed, especially with reference to the export situation, the future and spot markets would have righted themselves much more quickly than they did. Because of these unusual conditions, quotations for Middling cotton at times have been quite at variance in many of the markets, but when all things are considered, uniformity and proper parity have been remarkably well maintained.

DETERMINATION OF DISPUTES.

There has been a decrease of more than 50 per cent in the number of disputes heard as compared with the number heard during the last fiscal year and a much larger decrease in the number of bales involved in the disputes. Among the reasons for this decrease are the excellent grade of cotton delivered on contract, the policy of forwarding to Washington only the bales in a contract that were disputed instead of the entire contract, and the unusual situation existing in the cotton trade. Only 8 of the 158 disputes received during the year included all the bales of the delivered contract. No disputes were received from New Orleans.

The stock of certificated cotton in New York averaged Strict Middling or better, practically no low grade cotton having been listed. Much of the cotton delivered on contract during the year was being redelivered and had been passed upon by the department previously.

The following table presents in convenient form, by months, the number of original disputes and the number of replacement disputes received and the number of bales involved:

Disputes referred to the Department of Agriculture under the cotton-futures act, year ended June 30, 1917.

Month.	Original disputes.		Replacement disputes.		Month.	Original disputes.		Replacement disputes.	
	Num-ber.	Bales.	Num-ber.	Bales.		Num-ber.	Bales.	Num-ber.	Bales.
July.....	35	1,559	.....	.....	February.....	.....	.....	.....	.....
August.....	9	444	.....	.....	March.....	5	238	3	11
September.....	4	298	.....	.....	April.....	.....	.....	.....	.....
October.....	14	803	.....	.....	May.....	1	91	.....	.....
November.....	3	192	.....	.....	June.....	2	35	.....	.....
December.....	55	1,186	.....	.....		155	5,903	3	11
January.....	27	967	.....	.....			

The total sum collected as costs for the determination of the disputes heard during the fiscal year was \$1,664.35, of which \$838.72 was assessed against the complainants and \$825.63 against the respondents. All this fund was covered into the Treasury of the United States in accordance with the provisions of the act.

PREPARATION AND DISTRIBUTION OF PRACTICAL FORMS OF THE OFFICIAL COTTON STANDARDS OF THE UNITED STATES.

The preparation and distribution of practical forms of the Official Cotton Standards of the United States is under the direction of Mr. Fred Taylor. The number of such sets prepared and sold or allotted during the fiscal year was as follows: Sets sold to the trade in the United States, 189; sets sold in foreign countries, 30; fractional sets sold in the United States, 44; sets furnished to demonstration agents in the United States, 125; total received from sale of sets, \$2,358. In order to maintain accuracy in the preparation of these sets, the reference set was frequently checked against the original set and the sets kept in vacuum.

It has been difficult during the past season to purchase the lower grades of cotton suitable for the work on the standards. As a result many bales purchased could not be used and \$24,487.40 was received for such rejected cotton when sold.

The standards have been adopted by 32 of the leading cotton markets of the United States and are used extensively by the trade. As previously stated, the Rotterdam Cotton Exchange adopted the standards during the past season. The total distribution shows 843 full sets and 115 fractional sets of the white standards, and 73 full and 9 fractional sets of the colored standards in use on June 30, 1917.

Inspection of 347 of the sets of white standards during the latter part of the year has shown 1,728 boxes in good condition, 635 entire

boxes canceled, and 716 individual samples of the respective standards canceled. Of the boxes canceled, 91.18 per cent were of the grades of Middling and below. Of the individual samples canceled, 77.09 per cent were of the grades of Middling and below, which indicates that the lower grades deteriorate more rapidly with use than do the higher grades.

Total distribution of practical forms of the Official Cotton Standards of the United States, by States, to and including June 30, 1917.

State.	White.		Colored.		State.	White.		Colored.	
	Full.	Fractional.	Full.	Fractional.		Full.	Fractional.	Full.	Fractional.
Alabama.....	49	5	4	.....	New Hampshire.....	7	1	.....	.....
Arizona.....	1	.....	.....	.....	New Jersey.....	2	.....	.....	.....
Arkansas.....	49	3	2	.....	New York.....	54	9	9	.....
California.....	10	.....	.....	.....	North Carolina.....	61	13	2	2
Connecticut.....	2	4	1	.....	Oklahoma.....	34	1	.....	.....
District of Columbia.....	3	.....	1	.....	Pennsylvania.....	6	5	2	.....
Florida.....	2	.....	.....	.....	Rhode Island.....	10	11	.....	.....
Georgia.....	97	7	12	1	South Carolina.....	79	12	5	2
Illinois.....	1	1	.....	.....	Tennessee.....	29	7	3	.....
Indiana.....	3	.....	.....	1	Texas.....	151	5	11	1
Kentucky.....	1	1	.....	.....	Vermont.....	1	.....	.....	.....
Louisiana.....	41	2	2	.....	Virginia.....	4	.....	2	.....
Maine.....	5	1	.....	.....	Washington.....	.....	.....	.....	1
Maryland.....	1	1	.....	.....	Total:	.....	.....	.....	.....
Massachusetts.....	74	23	10	1	United States.....	821	114	65	9
Ohio.....	1	.....	.....	.....	Foreign.....	22	1	8	.....
Minnesota.....	1	.....	.....	.....	Grand total.....	843	115	73	9
Mississippi.....	6	1	.....	.....			
Missouri.....	6	1	.....	.....			

Grand total, grade and color..... 916
 Grand total, fractional sets, grade and color..... 124

UNITED STATES GRAIN STANDARDS ACT.

The active administration of this act has remained under the direct supervision of the chief of the bureau, assisted chiefly by Mr. George Livingston, and also by Dr. J. W. T. Duvel, and other experts from the grain staff. As the work is entirely new, it is reported in some detail.

The United States grain standards act was passed on August 11, 1916, and the supervision of the inspection and grading of grain under the act was put into active operation December 1, 1916.

ADMINISTRATION.

RULES AND REGULATIONS.

Tentative rules and regulations for the enforcement of the act were drafted as soon as possible and submitted to the entire grain trade of the country for criticism and suggestion. They involved the study and observation of experts of the Department of Agriculture covering a long period of years. Public hearings were held at important grain markets of the country and were attended by representative interests among the grain trade. The comments and suggestions received at such hearings and by written communication were embodied in the final form of the rules and regulations cover-

ing the inspection and grading of grain under the act, the licensing of inspectors performing such work, and the activities of the department called for by the provisions of the act, and issued as Circular 70 of the Office of the Secretary.

SUPERVISION.

For the effective enforcement of the act the United States was divided into 32 supervision districts, the office of Federal Grain Supervision in each district being put into operation on December 1, 1916, under a grain supervisor. These offices were located at markets available to all other grain marketing points in the territory covered and are equipped with laboratory apparatus for investigational work and for the determination of the grade of grain handled in supervision work and for the determination of cases involving appeals and disputes. Four additional offices were equipped for operation on July 1, 1917. As one of the offices established on December 1 has been discontinued, 35 offices are now in operation.

Inspectors of grain are licensed by the Department of Agriculture but are not employees of the department. The work of licensing and supervising inspectors is reported on a later page. Service and Regulatory Announcements Nos. 14, 17, and 25 give information to the public regarding boundaries of the supervision districts, location of offices of Federal grain supervision, licensed inspectors, and related matters.

TRAVELING SUPERVISORS.

A constant effort has been made to make uniform the procedure followed in the field offices in the supervision of inspection and grading work. Five of the most experienced and competent grain supervisors have been designated as traveling supervisors in addition to the regular duties at their own stations. These traveling supervisors have visited the supervision offices in the territory assigned to them, checking up the work of such offices and insuring uniformity in the activities conducted in the Federal grain supervision work.

CONTACT WITH LICENSED INSPECTORS AND GRAIN TRADE.

Licensed inspectors performing inspection and grading work under the provisions of the act and all parties affected by the operation of the act have been advised through personal visits by the supervisors in the respective districts, through correspondence, and through published announcements, as to the operation of the act and the interpretations placed by the department upon different provisions of the act and the rules and regulations of the Secretary thereunder as applied to specific cases presented to the department. This activity has resulted in close cooperation with the grain trade and insured the uniform application of the provisions of the act. The published announcements were issued as Service and Regulatory Announcements Nos. 13, 15, 17, and 18.

STANDARDS FOR SHELLED CORN AND WHEAT.

Official grain standards of the United States for shelled corn were promulgated on September 1 and were published as Service and

Regulatory Announcements No. 11. They became effective on December 1, 1916. The supervision of the inspection of shelled corn moving in interstate commerce has constituted the main activity of the field offices of Federal grain supervision from December 1, 1916, to July 1, 1917, the entire movement of the 1916 crop falling within the operation of the act. Tentative standards for wheat were published in February, 1917, as Service and Regulatory Announcements No. 19, and were distributed among the trade and considered at public hearings held in all the great grain sections of the United States. Written suggestions submitted to the Department and the comments and suggestions received at such hearings were embodied in the final standards made effective on July 1, 1917, for winter wheat and on August 1, 1917, for spring wheat. They were issued as Service and Regulatory Announcements No. 22. Studies are now under way for proposed standards for other grains, particularly oats, and will be placed before the public in tentative form as soon as practicable.

LICENSING OF INSPECTORS.

The licensing of inspectors to inspect and grade grain for which official standards have been established under the United States grain standards act was begun in November, 1916, under Mr. K. B. Seeds. Where applications indicate the requirements specified in the act and the rules and regulations established by the Secretary of Agriculture thereunder, applicants are examined to determine their qualifications and fitness for license. Licenses have been prepared and issued to all persons found qualified who meet the requirements of the law.

APPLICATIONS AND EXAMINATIONS FOR LICENSE.

On June 30, 1917, applications had been received from 369 persons for license to inspect and grade shelled corn according to the official standards and from 305 persons to inspect and grade wheat. Application forms have been supplied each person and the applicant is required to indicate whether he is authorized to inspect and grade grain under the laws of a State maintaining a State grain inspection department, that he is 21 years of age, has had one year's experience as grain inspector in the determination of the grade of grain for which license is sought, and is provided with necessary apparatus to determine the grade of grain. He must submit also a schedule of fees charged for inspection services, and must indicate the points at which service is performed.

Three hundred and thirty-three persons have been licensed to inspect shelled corn and 252 persons licensed to inspect and grade wheat. Of these licenses, 251 are held by persons authorized to inspect and grade both shelled corn and wheat. Twenty-eight applicants for license as inspectors of shelled corn and 12 applicants for license as inspectors of wheat failed to show the necessary qualifications, and examination and license were refused. Twelve applicants for license to inspect shelled corn were found deficient on examination, and 8 applicants for license to inspect wheat did not show the necessary qualifications upon examination.

The fees charged for the services of inspectors have been carefully guarded, and in some instances inspectors have been required to

lower their charges and to discontinue practices of performing services to individuals or organized groups of dealers at charges which were unfair, excessive, and discriminatory.

INVESTIGATION OF COMPLAINTS AND REVOCATION OF LICENSES.

Constant touch with licensed inspectors has been maintained. Two inspectors have been found who apparently engaged in work or formed business connections which disqualify them from holding licenses. Charges have been preferred and submitted to these inspectors directing them to show cause why their licenses should not be revoked.

SUPERVISION OF INSPECTION.

Through the Offices of Federal Grain Supervision and under the direction of Mr. George Livingston the inspection and grading of grain and the uniform application of the grades are carefully supervised. The grain supervisor is aided by grain samplers who secure representative samples of grain for checking up the work of licensed inspectors performing inspection and grading service and for determining appeals and disputes under the act. Assistant grain supervisors are stationed in the districts where the volume of inspection and grading work necessitates their assignment. The offices are equipped with standardized laboratory apparatus for the making of moisture and other determinations upon samples of grain necessary in arriving at the true grade of such grain.

STANDARDIZATION OF SUPERVISION ACTIVITIES.

Contact with the field force in the supervision work has been standardized, in so far as practicable, with a view to obtaining uniform understanding in application of the act at all stations. Twenty numbers of an information bulletin have been issued and distributed from the Washington office to the field stations. Instructions of a general nature regarding the work, the activities to be followed, and methods applicable in the conduct of such work are included in the series.

Besides the constant supervision of inspection work performed by inspectors licensed under the act, methods of handling shipments at the large grain markets have been investigated, as have brokerage and commission charges, operation of the various grain exchanges, boards of trade, chambers of commerce, sampling bureaus, and other grain marketing organizations.

From December 1, 1916, to June 30, 1917, 237,595 cars of shelled corn were inspected and graded by licensed inspectors according to the official standards of the United States. Reports of such inspections have been checked by officials at the supervision offices and the work of the inspectors kept under constant observation. Ten thousand six hundred and fifty-five official samples of shelled corn have been secured by such field offices and determinations made of the grade. The efficiency of the inspection and grading work performed by inspectors throughout the United States is reported to have been materially increased, and the improvement in efficiency together with the use of uniform standards in all markets is apparently highly satisfactory to all branches of the trade.

INVESTIGATION OF COMPLAINTS AGAINST INSPECTORS.

One hundred and one cases of complaint against the work of inspectors have been investigated by the bureau, and the circumstances surrounding the shipment of the grain claimed to have been incorrectly graded ascertained. Where inspectors have been found in error the reason for misgrading has been determined and action taken to insure against repetition of such fault, and in other cases the complainant has been advised of the conditions and assistance has been rendered where a clear knowledge of the operation of the act and of the official standards was not evident. Action regarding the possible revocation of licenses has already been mentioned. Records of all complaints against inspectors have been maintained.

STATISTICAL REPORTS.

Reports of the work performed by licensed inspectors are received and compiled at the Washington office. Such reports are first checked by the supervision offices in the field to insure compliance with the requirements of the act and the rules and regulations thereunder. Through such reports complete information is available regarding each inspection made, the grade assigned, and the quality and quantity of the grain inspected. Reports also have been received and compiled as to shipments by grade between noninspection points which are not inspected and graded by licensed inspectors. The data from such reports have been summarized in report form as of July 1, 1917, in accordance with the requirements of the act. They have been published as Service and Regulatory Announcements No. 23.

STANDARDIZATION OF INSPECTION AND REPORT FORMS.

All forms of inspection certificates issued by licensed inspectors have been carefully examined to enforce compliance with the rules and regulations under the act. Suggestions have been made, where necessary, and forms which meet the requirements have been approved for use by the inspectors. Suggested forms for submitting reports required by the act also have been prepared and distributed among grain shippers, and standardized forms for use at the Offices of Federal Grain Supervision have been developed and put into use by such offices in the conduct of their work. Practically every operation required in the carrying out of the work of the act by shippers, inspectors, or employees of the Department of Agriculture has been standardized to the end that the results of the work may be intelligently interpreted and comprehensive and conveniently available records may exist.

COOPERATION WITH THE GRAIN TRADE.

Through personal visits, correspondence relative to specific inquiries, the publication of service announcements, and addresses by members of the field force and of the Washington office, the operation of the act has been made known to all parties in the grain trade. It is probably not too much to say that the inspection and

grading of grain, since the putting into operation of the provisions of the United States grain standards act, has been placed on a uniform and sounder basis.

DETERMINATION OF DISPUTES AND APPEALS.

Work on the determination of disputes and appeals is directed by Mr. E. G. Boerner.

Appeals from the inspection and grading of grain by licensed inspectors are filed by parties to the transactions with the Office of Federal Grain Supervision in the district in which the inspection and grading were performed. The supervisor in charge of such office determines the jurisdiction to entertain the appeal, causes official samples of such grain to be taken and analysis determinations made, and issues to the respective parties to the transaction memoranda of the true grade of the grain. The record of such appeal or dispute is forwarded to the Washington office, together with advance costs collected from the appealing party. The advance deposits are transmitted by the Washington office to the disbursing officer of the department, the record of the appeal is carefully checked, and review is made of the analysis separations of the samples of grain involved. The formal findings of the Secretary of Agriculture covering the appeal are then prepared and sent to the party, with any refund due after deducting from the advance costs the costs incurred by the department. Refunds of the entire deposit are made in cases where the appeal is sustained. The costs assessed by the department are covered into the Treasury of the United States.

From December 1, 1916, to June 30, 1917, 300 appeals and 1 dispute were filed with the Offices of Federal Grain Supervision. Seven appeals were dismissed for lack of jurisdiction and 293 were entertained. In 83 such cases the complaint was found justified, the appeal sustained, and refund made of the costs deposited with the department. In 210 cases the grade assigned by the licensed inspector was determined to be correct, the appeal was not sustained, and the costs assessed were covered into the Treasury.

LABORATORY METHODS AND PROCEDURE.

Much assistance has been rendered to members of the grain trade, to grain inspectors, and to the grain inspection departments of boards of trade, grain exchanges, and other organizations with regard to the proper methods and procedure employed in the sampling, testing, and analyzing of grain. Standardized methods have been developed in the entire procedure of laboratory work of the Offices of Federal Grain Supervision in the field, and detailed instructions in the handling of appeal and dispute samples and samples of grain secured in the supervision work proper have been prepared and distributed to such offices. Laboratory equipment in the Offices of Federal Grain Supervision and at the Washington office has been arranged for and installed with a view to absolute uniformity in the work performed. The laboratory equipment in such offices has been standardized and the working conditions in the laboratories made uniform in so far as the available space would permit.

New and improved laboratory equipment has been developed for work in determining the grade of grain, and tables of equivalents for use in analyzing work prepared and distributed. This equipment has included apparatus for determining the weight per bushel of different grains; grain probes used in sampling work; remodeled dock-age machines; newly designed laboratory tables for analytical and review work; a portable grain sampling device; and charts and tables of equivalents for wheat sample analysis work.

BOARD OF REVIEW.

All analysis separations of grain samples made in the field offices have been reviewed at the Washington office by a board consisting of five thoroughly experienced analysts, namely, Messrs. E. G. Boerner, H. J. Besley, W. J. O'Loughlin, C. A. Russell, and J. F. Chilton. The corrected separations have been returned to the laboratories from which received, and, as a result, the laboratory work of each office is standardized and the efficiency of the employees in the field offices engaged in analytical work is materially increased. The uniformity in the laboratory work in the field is also reflected in the work of the licensed inspectors, who are constantly under the supervision of the grain supervisor and his assistants in the district in which such inspectors are located.

THE UNITED STATES WAREHOUSE ACT.

Much work has been done preliminary to the administration of the United States warehouse act under the direction of Messrs. D. S. Murph and R. L. Nixon. This work consists of investigations of storage conditions and the establishment of lists of warehouses for the storage of the various products. Lists of tobacco and wool warehouses have been developed and kept up to date. By means of a detailed inquiry sent to these warehouses, much information has been obtained relative to storage capacities, charges for storage, insurance rates, and related matters, which will be of value in the administration of the act. Similar data had been obtained previously from cotton warehouses in the course of the cotton warehousing investigations of the bureau. The lists of grain elevators and warehouses developed in connection with the enforcement of the grain standards act are available for work under the warehouse act.

The tentative rules and regulations and the necessary forms to be used in the enforcement of the United States warehouse act have been drawn up, and conferences and hearings will be held during October, 1917, with warehousemen, insurance men, representatives of the bonding companies, and others interested, to determine the final form of rules and regulations. It is expected that in the near future the act, which is permissive only, will be put in operation. Work under this act has necessarily been delayed because of the great amount of legal work demanded of the Solicitor's Office of the Department of Agriculture in connection with the many laws intrusted to the department for administration.

Much interest in the legislation has been shown by warehousemen, bankers, and others. Letters are now being sent to bankers in the cotton and tobacco producing sections of the country calling atten-

tion to the legislation and asking for special information to be used in its administration.

ENFORCEMENT OF THE UNITED STATES STANDARD CONTAINER ACT.

The United States standard container act, approved August 31, 1916, to become effective November 1, 1917, is an important forward step in package standardization. In cooperation with manufacturers and shippers, the Bureau of Markets has devoted much time to the determination of the sizes and types of packages to be standardized by this legislation. The proposed regulations for the enforcement of the act were prepared and distributed among shippers, dealers, manufacturers, and others for criticism and suggestions. The final regulations were adopted and promulgated by the Secretary of Agriculture on September 18, 1917, and were issued as Circular 76 of the office of the Secretary.

TOTAL AMOUNT COVERED INTO TREASURY.

The total amount covered into the Treasury of the United States as a result of the regulatory work of the Bureau of Markets from the time such work was begun to September 15, 1917, is as follows: From sales of practical forms of Official Cotton Standards, \$15,813.40; from sales of rejected cotton, \$73,225.90; from charges assessed for the hearing of disputes under the United States cotton futures act, \$26,510.80; from the sale of grain samples, \$518.71; from charges assessed for the hearing of disputes under the United States grain standards act, \$867; making a total of \$116,935.81.

REPORT OF THE CHIEF OF THE OFFICE OF FARM MANAGEMENT.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
OFFICE OF FARM MANAGEMENT,
Washington, D. C., October 1, 1917.

SIR: I am submitting herewith the annual report of the Office of Farm Management for the fiscal year ended June 30, 1917.

Respectfully,

W. J. SPILLMAN, *Chief.*

Hon. D. F. HOUSTON,
Secretary of Agriculture.

The emergency arising from the participation of this Government in the European war has caused some realignment of work in this office during the past year. Such projects as were of special value during the emergency were continued and enlarged, while those having less bearing on the present situation have been partly or wholly discontinued until more normal times.

FARM-LABOR PROBLEM.

Shortly after our participation in the war began the responsibility of handling the farm-labor problem was assigned to this office. Offers were made to the various State Councils of Defense or to State committees on food production and conservation to furnish a man to assist in organizing the State for dealing with the farm-labor situation. Nearly all the States accepted this offer. As rapidly as possible the various States were organized and the labor needs of the farmer ascertained. The organization which was perfected supplied these needs, in so far as it was possible, from those who were found available for farm work in rural and village communities and in agricultural schools and colleges. Where deficiencies could not be met in this manner, they were called to the attention of the United States Department of Labor, with which department an excellent co-operative understanding had been arranged. There have been very few cases where any material shortage of labor has not been supplied during the year. In some of the mountain States there was difficulty because of the distance necessary to move laborers and the absence of funds for paying their transportation.

The organization formed in the various States did not provide for an enumeration of the amount of help furnished farmers, and it is hence not definitely known just how many laborers were supplied to the farmers. It is known, however, that the number was very large.

CROP ECONOMICS.

For many years the office has been cooperating with a number of farmers in the matter of farm records. Records covering the full details of the farm business have been kept on these farms. The experience of the past year has given emphasis to the value of such

records. They have been a very fruitful source of information in connection with many problems that have arisen in this emergency.

During the past year enterprise records were obtained in the Greeley, Fort Morgan, and Rockyford districts of Colorado. Records were taken also in the Provo and Garland districts of Utah. Some 36 farm estimates were obtained in the Idaho Falls district of Idaho. Studies of this character were begun in southern California, and 88 records were obtained last year. In several of these areas records were obtained for two seasons in succession. An effort has been made to conduct these studies in typical areas.

During the summer of 1916 some studies were made on methods of making hay and the value of the sweep rake. Enterprise records were obtained in Georgia during the month of June. These included a study of methods of producing Johnson grass hay in the South.

Enterprise records pertaining to cotton production have been taken in practically all of the cotton-producing States, and the figures for these farms have been tabulated in part. Within the past year Department Bulletin No. 492, *An Economic Study of Farming in Sumter County, Georgia*, was issued.

During the summer of 1916 some attention was given to the study of orchard management in western New York and also in Virginia. The tabulation work of the New York survey has been practically completed and a report will be submitted in the near future. Three bulletins were published during the year.

Substantial progress has been made on the investigations dealing with the farm practice in production of corn silage, equipment required, use-cost of silos, shrinkage of silage, etc. Careful tests and weighings of silage have been made in cooperation with nearly 50 farmers, in addition to the complete results for 20 silos. These data furnish more information on capacity of silos and density of silage. Owing to the complexity of the problem, at least another year of field work is thought advisable to complete satisfactorily the shrinkage phase of this project.

The field studies on the economics of the farm wood lot were continued throughout a part of the year, and sufficient records were obtained to enable us to complete the office tabulations.

FARM BOOKKEEPING AND COST ACCOUNTING.

The studies of the various systems of bookkeeping as worked out by farmers and other individuals interested in this line of research have been continued. Additional information regarding the practicability of certain of these systems and methods has been compiled and several manuscripts are in course of preparation. Cooperative relations have been continued with several farmers, and as a result there has been a further accumulation of complete detailed sets of cost accounts. Cooperative relations also have been continued with the New York, Minnesota, and Wisconsin Experiment Stations and Colleges of Agriculture in obtaining complete sets of cost records from farmers. Substantial progress has been made in further tabulating for publication data obtained by cost accounts during previous years. A manuscript has been prepared dealing with the results of a five-year cost study on a tenant farm in western New York. Cost records for a series of years on other farms are available for similar manuscripts. Farmers' Bulletins 511, 572, 661, and 782 have

been published. Results obtained by virtue of cooperation with the New York State College of Agriculture, at Cornell University, have been published by that institution as Bulletin No. 377.

LIVE-STOCK ECONOMICS.

Part of the work for the past year has been a continuation of the investigation conducted cooperatively with the Bureau of Animal Industry. Three hundred and fifty additional records were procured, making a total of practically 1,000 for the three years.

FARM TENURE.

Investigations on tenant dairy farms were continued, particularly in Wisconsin and Illinois. In this work survey records were taken on 150 dairy farms, and a manuscript has been prepared for publication containing the results of this study. An inquiry into the method of renting dairy farms also was made in Delaware and Maryland. The material thus collected, when combined with that secured from farm management surveys in other regions, will be used as a basis for further discussion of tenancy on dairy farms. A study of tenancy on wheat farms was begun during the year. As a preliminary step in this work about 620 farm-tenancy factor sheets were prepared from survey records taken mainly by the States Relations Service. Field work in Kansas, Nebraska, South Dakota, North Dakota, and Minnesota supplemented this material with more than 400 farm survey records taken on tenant wheat farms.

During the year a bulletin was published on "The Systems of Renting Truck Farms in Southwestern New Jersey." A detailed study was also conducted on cost to landlord and tenant of crops raised on a New York share-rented crop farm. Two manuscripts have been prepared for publication as a result of this study. A beginning was made of the investigation of tenancy on stock farms. About 300 tenant factor sheets were prepared from survey records taken in various States by the States Relations Service and the Iowa Agricultural College. This material will be supplemented by field work in Ohio, Indiana, Illinois, Michigan, Iowa, and Missouri on tenant farms on which live stock is an important enterprise.

In a study of lease contracts used in renting farms nearly 300 lease contracts in actual operation were examined, every State being represented. The number of farm survey records studied with regard to the essential features of a lease agreement was 2,900, being taken on dairy farms, stock farms, general farms, and farms on which wheat, potatoes, sugar beets, beans, tobacco, and other crops were especially important enterprises. This study has served to show the great variation in the lease contracts under different conditions.

FARM PRACTICE IN ITS RELATION TO THE MAINTENANCE OF CROP YIELD.

The work of the past year has been devoted very largely to the tabulation, digesting, and writing up of results obtained in previous field work, in particular a special study of certain highly productive farms which were a part of the farm-management survey made in Chester County, Pa., and a study of a 1,500-acre ranch in southern California which had been cropped in sugar beets until the yields had

dropped so low that no profits could be made. In this case, by four years of intelligent management, the yields were doubled and the net returns per acre increased to almost \$40.

LOGGED-OFF LANDS.

Further studies have been made on the economic conditions under which farms are being cleared from logged-off lands. Owing to the fact that no appropriation for the continuation of this work was made by the last Congress, this report marks the close of the project.

HISTORY AND DISTRIBUTION OF FARM ENTERPRISES.

The principal work of this section has been in connection with the Atlas of American Agriculture. Chapters on frost and precipitation have been sent to the printer, one map of precipitation in the United States has been issued as an advance sheet, and a map of the topography of the United States in black and white, with altitudinal tints, and chapters on cotton and on rural population have been submitted for publication. The following will be ready in a short time for publication: Chapters on wheat, corn, sheep in the United States, and land tenure, as well as the section on seasonal distribution of labor. Other bureaus working cooperatively on the atlas have contributed the following: A chapter on native vegetation in the United States, with a detailed map, by the Forest Service and the Bureau of Plant Industry; a chapter on grain storage, by the Bureau of Markets; also a map showing the agricultural regions of the United States has been prepared in the office, and text to accompany it has been prepared by a member of the faculty of the University of Cincinnati. Considerable progress has been made in the preparation of the chapters on dairy cows and on horses and mules. Maps showing the seasonal distribution of farm labor for rye, hay, and truck crops have been drawn once, but most have required revision. During the summer half of the wheat maps were put into final form; many of the corn maps were finished; rye dates were partially entered; and a small start was made on the truck-crop section.

In addition to the work on the atlas four bulletins have been offered for publication.

In connection with the farm labor emergency the following have been furnished:

For the Department of Labor.—United States maps showing the average dates when harvest of winter wheat begins and becomes general, when harvest of spring oats begins, and when harvest of spring wheat begins. Each week copies of maps were furnished showing the progress of the wheat and oats harvest in 1917.

For farm help specialists and State labor commissioners.—Harvest maps of winter wheat, spring oats, and spring wheat were supplied for twenty-six States. These maps showed by counties the average and extreme reported dates of harvest, the 1910 acreages by counties, and a comparison of the 1910 with the 1917 State total acreages of the crops represented. Similar barley and corn maps were made for Minnesota and corn maps for New Jersey. In addition, a number of special maps were made for different agencies.

A number of wheat-seeding calendar maps, showing the best time for seeding winter wheat, have been prepared and sent to experiment

stations in the important wheat States in the eastern half of the country.

FARM ORGANIZATION.

The work of the farm organization section of the office may be summarized by a few outstanding features which have marked the progress during the fiscal year 1916-17. In previous years considerable time has been spent in collecting data from farms, and although much additional information has been taken this last year more attention has been given to summarizing and digesting the material at hand.

FARM SURVEYS.

Very important progress has been made with the survey work, particularly in summarizing the results from the areas where records have been taken over a period of years. These have been especially valuable from the standpoint of showing the profits and returns on investment that farmers receive from their business over a five-year period and the effect that crop failures or losses of live stock from disease have upon the returns from the business. Frequently a farmer has moved from a small farm to a large one, and records have been obtained for several years on both places under the same management. Such data have been especially useful in supplementing the more extended studies on the size of the farm business with reference to efficient operation.

Extensive data have been collected on the means by which farmers obtain a foothold on the land.

A very important part of the farmer's living is received directly from the farm in the form of garden products, milk, eggs, meat, use of the house to live in, etc. A very careful analysis has been made of this direct income to the farmer and his family. These data show the relative importance of the garden, poultry, orchard, etc. A very mistaken notion is often held with regard to the garden products, which constitute a comparatively small percentage of the products received direct by the farmer and his family, the milk, eggs, and meat products being of outstanding importance. Supplementing this study an analysis has been made of the garden itself to determine which classes of vegetables contribute most effectively toward the farmer's living. These studies show what a garden really is worth to the family.

Several publications have been issued dealing with the various phases of the survey work. These pertain mainly to the results obtained on specific investigations. Considerable assistance has also been rendered investigators in colleges and institutions with reference to methods of conducting surveys, so that at present practically all the research agencies in the United States are following comparatively uniform methods. This standardizing of methods has been of great value in that it permits a comparison of results obtained by different agencies.

FARM MACHINERY AND EQUIPMENT.

The farm machinery and equipment work has been characterized by studies aimed to conserve farm labor and to make the use of farm implements more efficient. Particular attention has been paid to the study of farm tractors, and a great service has been rendered, not only in the way of publications on this subject, but in bringing to-

gether the various tractor agencies and determining the real place of a tractor on the farm. Attention has also been given to time studies with reference to certain hand operations, with a view to determining the most efficient methods of performing such work.

SPECIFIC ORGANIZATION PROBLEMS.

Farm organization studies with reference to specific problems in the various districts have been greatly influenced by the present war emergency. Many of the workers have been detailed to other duties, so that several projects which were well under way and which would have been completed this season have been temporarily laid aside. Although there have been several lines of work carried on in each of the agricultural districts, only a few of the outstanding features will be mentioned here.

NORTHEASTERN AND NORTHERN DAIRY REGION.—The two prominent problems in this area are: First, providing an adequate supply of concentrated feeds for live stock; second, the farm labor question.

Within the past year the prices of all concentrated grains have risen almost to unprecedented levels, until at present corn meal is selling at \$96 per ton in some of the rural districts in these States. This region, being mainly one of dairying and other intensive agriculture, purchases a very large proportion of the concentrated grains fed. Such practice of depending upon purchased concentrated feeds permits the farm operator to maintain a herd of dairy cattle the size of which depends upon the extent to which he can grow roughage for the winter feeding and provide pasture during the summer. The specific farm management problem is to devise systems of farming which will provide as much of these protein feeds as possible in the form of corn silage, alfalfa hay, soy beans, oats and peas, and grains wherever practicable.

The second problem is that of obtaining a sufficient amount of labor. This is rendered more difficult by reason of the proximity of large industrial centers, where workmen are employed at much higher wages than the farmer is able to pay. Again, the type of farming in the northern and eastern States is such that considerable hand labor is needed in the production of potatoes, truck crops, small fruits, etc. Machinery can not be used to take the place of this labor and, if the shortage continues, many of these intensively worked farms will eventually be reorganized on a less intensive basis.

Middle Atlantic region.—The Middle Atlantic region embraces large areas where crop yields have declined to a very low level and where an effective system of building up the farms to a profitable condition is the first consideration. Splendid results have been obtained with reference to the farm practices followed by successful farmers in building up rundown lands. Such information, when intelligently applied, will be of inestimable value to the farmers of the States along the middle and southern Atlantic coast.

Equally valuable work has been conducted in the more remote and mountain districts of the Middle Atlantic States with reference to systems of farming that are profitable under adverse conditions. Much information with respect to the costs and returns of these farms has been collected and compiled and several bulletins concerning the same issued.

Cotton belt.—The outstanding farm-management problem of the cotton belt is to maintain yields of cotton and corn, the two leading

crops in the South. It has been conclusively shown that the yields of crops are the determining factors in the profitability of the southern farm. With the boll weevil gradually extending over more and more of the cotton belt, it is imperative that systems of farming be developed which will, in a measure, replace the income lost through the decreased returns from the cotton crop. Very substantial progress has been made by our workers with respect to, first, systems of live-stock farming which may be developed with corn and forage crops; second, the development of the soy bean as a cash crop for seed, feed, or oil. Investigations have been carried on to determine how the soy bean may be fitted into a rotation with cotton and corn and its place in southern agriculture. Attention has also been given to peanuts and other leguminous crops with respect to their place on these farms.

Corn belt.—Corn belt agriculture is based primarily on live stock, mainly beef cattle and hogs, and the production of corn and small grains. With the increasing scarcity of all food products, it is imperative that as much grain as possible be saved. Our studies in the corn-belt States have been along the lines of developing systems of live-stock farming which will maintain maximum production of hogs and cattle with the minimum use of corn and other concentrates. This is accomplished largely by the introduction of alfalfa and other forage crops in the rotation, and so arranging these as not appreciably to upset the labor requirements of the average corn-belt farm. Very substantial progress has been made on this problem.

Great Plains Region.—Probably one of the greatest problems in building up a permanent agriculture in the plains region is the uncertainty of rainfall and consequent crop production. Our attention, therefore, has been turned to finding and developing systems of farming which are as permanent as possible under the conditions in those regions. This permanency is particularly desirable from the standpoint of maintaining a supply of roughage so that the live stock may not be sacrificed in scant crop years. The second important problem is that of maintaining crop yields, particularly with reference to grains. The third problem is that of systems of farming which will maintain the fertility of the soil, especially with reference to the supply of humus.

Pacific Coast and Mountain Region.—The agriculture in these States is so varied that there are innumerable farm-management problems, many of which bear very little relation to each other. One of the most prominent is the development of profitable systems of farming in the irrigated districts. Unfortunately, in the development of these irrigated areas the farms were made altogether too small in area for profitable operation, except under the most intensive forms of agriculture. There being no extended markets for these intensive crops, a readjustment has been necessary, and this readjustment has not come about without appreciable loss to many of the earlier settlers on these irrigated projects. With this readjustment the introduction of live stock and accompanying forage crops has been of prime importance. Our activities have been centered largely around this problem of working out suitable systems of live-stock management for irrigated farms. Coupled with this is the problem of the alfalfa weevil, and studies have been inaugurated

with reference to the farm practices in relation to the control of this weevil.

In all of these farm organization studies a number of manuscripts have been prepared dealing with the more important findings. The most pertinent problems will be continued during the ensuing year, as it seems that such investigational work is of prime importance, even in these days of great emergency when no effort should be expended except such as promises immediate results.

COOPERATIVE FARM MANAGEMENT INVESTIGATIONS IN THE SOUTHERN STATES.

In January, 1917, the Office of Farm Management entered into an agreement with the Office of Extension Work, South, this department, and subsequently into practically identical agreements with the extension divisions of a number of the agricultural colleges in the Southern States, for cooperative investigations and extension work in farm management. The finances of the project are shared to a greater or less extent by all parties to the agreement.

The main object of this cooperation is to assist the State extension divisions and county agents in the Southern States (a) in ascertaining the relative importance of the principal factors that influence profits and losses on the farm and (b) in demonstrating to farmers practical and efficient methods of summarizing and analyzing the business of their farms as a means of measuring profits and losses incurred in managing them and in deciding upon readjustments that promise to increase the net income.

Under this agreement a farm-management specialist has been appointed to take charge of the work, and State farm-management specialists are assigned to the various Southern States as available funds and opportunity for cooperation present themselves. The State farm-management specialists act with and through the county agents and work among the farmers in the two-fold capacity of investigators and teachers. As investigators they make studies of the prevailing farm practices and methods of management in communities of 20 to 100 farms to find out the degree to which these practices and methods underlie successful farming. As teachers they instruct the farmers in the importance of these economic facts and principles and assist them in so shaping their practices and management as to conform more nearly, if possible, to these principles. They also instruct the farmer in making inventories of his land, implements, stock, and supplies, and in keeping records of his business transactions through the year and from year to year. These yearly records are then made the basis for measuring the degree to which his individual management conforms to economic law and the best-known practices for the community, and also as a basis for determining such adjustments in his practices as promise to increase the net income of his farm.

Since the inauguration of this project various degrees of cooperation have been established with six States, and five other States are practically ready for cooperation when finances will permit.

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